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NATIONAL BUREAU OF STANDARDS AUTHORIZATION

HEARING

BEFORE THE

SUBCOMMITTEE ON
SCIENCE, TECHNOLOGY, AND SPACE

OF THE

COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION UNITED STATES SENATE

NINETY-NINTH CONGRESS

FIRST SESSION

ON

NATIONAL BUREAU OF STANDARDS AUTHORIZATION

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NATIONAL BUREAU OF STANDARDS AUTHORIZATIONS

TUESDAY, MARCH 26, 1985

U.S. SENATE,
COMMITTEE ON COMMERCE, SCIENCE, AND TRANSPORTATION,
SUBCOMMITTEE ON SCIENCE, TECHNOLOGY, AND SPACE,
Washington, DC.

The subcommittee met, pursuant to notice, at 9:40 a.m., in room SR-253, Russell Senate Office Building, Hon. Slade Gorton (chairman of the subcommittee) presiding.

Staff members assigned to this hearing: Charlene Woods, staff counsel, and Pat Windham, minority professional staff member.

OPENING STATEMENT BY SENATOR GORTON

Senator GORTON. Welcome to this hearing on the plans and programs of the National Bureau of Standards for fiscal year 1986.

The National Bureau of Standards is an agency with an extremely broad mission, relevant to nearly every national problem area and every economic sector. Many of us take for granted the measures, standards, and technologies developed at the Bureau which affect us daily. For example, scientists at the Bureau developed an ultrasound device for identification of tumors which is significantly cheaper and safer than the use of most advanced x ray instruments. The Bureau first made it possible for radios to operate on household current, and the performance standards for flammability of children's sleepware and for residential smoke detectors were developed by Bureau scientists.

Of particular interest to my home State of Washington, the Center for Applied Mathematics at the Bureau developed several models for more efficient and economical fishery management for Washington State salmon fisheries along the Columbia River. These models continue to provide an intelligent basis for management of this precious and scarce natural resource.

At today's hearing, we will examine closely the proposed budget for fiscal year 1986 for the National Bureau of Standards. There are substantial budget decreases, as well as several new initiatives.

In the National Engineering Laboratory, both the Center for Building Technology and the Center for Fire Research are proposed for elimination. In addition, the Institute for Computer Sciences and Technology is proposed for drastic reductions.

New initiatives for the Bureau include a role for the Bureau in the rapidly growing biotechnology field, construction of a cold neutron research facility, increased funding for process and quality

control measurements, and funding for advanced ceramics research. We will scrutinize carefully those proposed changes, assess their impact on the overall mission of the Bureau, and then make our recommendations with respect to the budget for the National Bureau of Standards for fiscal year 1986.

Senator Gore, do you have an opening statement?

OPENING STATEMENT BY SENATOR GORE

Senator GORE. I am pleased to take part in this hearing on the National Bureau of Standards. The NBS performs a valuable function for this Nation by providing a research and measurement base for a variety of private section activities that are in the public interest. In my years in the Congress, I have been impressed by the quality of the work performed by the NBS, and I have been a supporter of the agency's many programs.

In his testimony today, the Director of the NBS presents this subcommittee with an impressive list of activities now being conducted, or soon to be conducted, by the Bureau. While I am pleased to see the NBS involved in so many worthy activities, however, I must voice my concern over two activities the NBS will not be conducting under its proposed fiscal year 1986 budget. I am speaking specifically of the proposed elimination of the Center for Building Technology and the proposed elimination of the Center for Fire Research.

Over the years, the CBT has proved to be one of the more valuable of the NBS' programs. The CBT has performed pioneering work on such areas as energy conservation in buildings and has led investigations into major structural failures, such as the collapse of the skywalk at the Kansas City Hyatt Regency hotel in 1981.

As chairman of the Science and Technology Subcommittee on Investigations and Oversight in the House of Representatives, I held hearings on the problem of structural failures. As one result of those hearings, I became convinced of the value of the CBT in investigating the cause of structural failures in this country and in preventing other failures in the future. The CBT has clearly performed its job well.

Additionally, and perhaps even more importantly, the CBT plays a central role in our national earthquake hazards reduction program. I come from a State—Tennessee—that could be severely affected by an earthquake along the New Madrid faultline. West Tennessee—and the city of Memphis in particular—could be especially hard hit. In order to minimize the damage that could occur, it is absolutely essential that we have the best available data on the possible effects of a major quake on buildings and other structures. The CBT is the best source for that information. Yet, the administration proposes to eliminate it.

It seems ironic that at a time when people in the Central and Eastern United States are beginning to become more cognizant in the need to take steps to protect themselves against earthquakes, the administration proposes to remove one of the best tools for helping these people help themselves. It is especially ironic since much-needed attention is at long last beginning to be focused on

the potential effects of earthquakes in the Central and Eastern United States.

The crucial role of the CBT in this area was highlighted at a hearing of this subcommittee last week on the Earthquake Reduction Act. Dr. Samuel Speck, the associate director for State and local programs at FEMA, told the subcommittee that FEMA relies heavily on the CBT for expertise in the Federal earthquake program. Although FEMA is the lead agency in the earthquake hazards reduction effort, it has nowhere near the expertise of the CBT in this area. Dr. Speck stated that if the CBT is eliminated, FEMA will likely have to contract out for the services now performed by the CBT. This would cost as much, and probably much more, than the current cost of the CBT's programs. I fail to see the logic in this proposal.

I am also concerned about the elimination of the Center for Fire Research. CFR's functions are varied and valuable. It both provides information and expertise to other agencies, like the Consumer Product Safety Commission, and conducts its own investigations into fire safety issues. The CFR performed the research that led to today's home smoke detectors, and it is currently working on ways to improve sprinkler systems and fire-retardant upholstery. The fire center's research has undoubtedly saved many lives and much money, and it will continue to do so.

The importance of the CFR becomes especially clear when one considers that without it, the United States would be the only major industrialized nation without a central fire research effort. To put our country in such a position is neither sound policy nor an efficient use of our fiscal resources.

Mr. Chairman, each year for the past several years, the administration has tried to eliminate these two extremely important programs. And each year the Congress has restored the funding for them. I know that we have witnesses here today who will speak in favor of the CBT and the CFR. I am glad they are participating in this hearing. I am also glad that we have the Director of the National Bureau of Standards with us today. I hope that he will try to explain the ra9tionale for what seems to me to be an unwise and uncalled-for decision to zero-out these centers.

Senator Hollings is sorry that he could not be here but he has asked me to submit a statement for him.

[The statement follows:]

OPENING STATEMENT BY SENATOR HOLLINGS

Mr. Chairman, as you know, I strongly believe that Congress must take swift and decisive action to reduce the Federal deficit. An important part of our strategy must be an effort to eliminate wasteful and unnecessary government spending.

We aren't serving America well, however, if we begin cutting programs which are undoubtedly sound and essential investments in our nation's economic health and in the safety of our people. To look to these programs for budget savings is to be penny-wise and pound foolish. The Administration's proposed budget for the National Bureau of Standards is a striking example.

This budget proposal contains some valuable new initiatives: process and quality control projects to help improve American manufacturing, programs to help U.S. industry with advanced ceramics and industrial biotechnology, and a "cold neutron source" that will allow neutrons from NBS's small reactor to be used to probe microscopic details of the advanced materials used in electronics and many other areas. These are important projects that will give American industry the instru-

ments and techniques it needs to stay competitive in the world marketplace. At a time when the President's Commission on Industrial Competitiveness has called for new Federal efforts to help American manufacturing, these initiatives—and the Bureau's programs in general—are sound investments in our economic future.

But rather than funding these projects on their own merit, the Administration proposes to pay for them by cutting some of the Bureau's most valuable existing programs. Three of the proposed cuts we have seen before—in fact, this is the fourth year we have seen them. They are the elimination of the Center for Fire Research (CFR), elimination of the Center for Building Technology (CBT), and a sharp reduction in the Institute for Computer Sciences and Technology (ICST).

Over the past three years, this Committee and our House counterparts have demonstrated, beyond any doubt, that these NBS programs are important social investments. The Fire Center made possible modern smoke detectors. Think of the benefits this modest investment has reaped in lives saved. If you want to talk fiscal savings, the Building Center has pioneered energy conservation techniques for office buildings, thereby saving millions of dollars in both the private and public sectors. ICST, which formulates and recommends standards for computers, has helped bring compatibility and order to that rapidly changing industry.

OMB claims that these are not Federal responsibilities, even though all three groups provide badly needed technical assistance to other Federal agencies. CBT is a central part of the Federal effort to reduce earthquake hazards to buildings. CFR advises the Consumer Product Safety Commission. Other Federal agencies turn to ICST for help with computer security. Think what the cost will be if Federal agencies have to turn to outside consultants for this help! OMB also claims, without a shread of evidence, that the States and the private sector will pick up these important projects if they are eliminated.

I find it sad, although not surprising, that OMB doesn't care about the thousands of American lives that are lost every year to fire or the thousands that could die in collapsing buildings during a major earthquake. I find it repugnant that OMB cuts these programs year in and year out, knowing that we support them and will restore them. It's all part of David Stockman's silly game of budgetary "chicken"—a ploy he uses to blame Congress for the Administration's huge deficits.

Once again, Mr. Chairman, I expect that the Congress will be more responsible than the Administration. There are wasteful activities in government that should be cut. These valuable programs are not among them.

Senator GORTON. We are pleased to have with us today, in addition to Dr. Ernest Ambler, Director of the Bureau of Standards, several outside witnesses who will aid in the evaluation of the Bureau's proposed budget. I would like to welcome: Mr. John Bush, board member of the National Institute of Building Sciences, Mr. John Gerard of the National Fire Protection Association; Mr. Vico Henriques, president of the Computer & Business Equipment Manufacturers Association; Mr. Pete England, president of the National Conference of Standards Laboratories; Mr. Fred Hume of John Fluke Manufacturing Co., Inc.; and Mr. Frank Samuel, president of the Health Industry Manufacturers Association.

Mr. Hume, I know that you have traveled all the way from my home State of Washington; and Mr. England, you have traveled all the way from California, and I want to extend a special welcome to both of you.

We will begin with an overview from Dr. Ambler, Director of the Bureau. Doctor, as you are well aware, your entire written statement will be included in the record and we would appreciate your summarizing it for us so we will have time for questions.

STATEMENT OF DR. ERNEST AMBLER, DIRECTOR, NATIONAL BUREAU OF STANDARDS, DEPARTMENT OF COMMERCE, ACCOMPANIED BY RAYMOND G. KAMMER, DEPUTY DIRECTOR

Dr. AMBLER. I will do that, Mr. Chairman.

I am accompanied by my Deputy Director, Raymond Kammer, and I am pleased to appear before you again to request authorizations for the National Bureau of Standards for fiscal year 1986.

NBS is requesting an appropriation of $120.1 million, which is a net decrease of $3,984,000 from the Bureau's current appropriation of $123,985,000. This request includes cost of living increases and built-in adjustments of $4,897,000, decreases of $8,819,000 as part of the President's deficit reduction program, and program increases of $16,444,000 which you mentioned, and decreases of $16,506,000 which you also mentioned.

I was pleased with the remarks you made about the work at the National Bureau of Standards, Mr. Chairman, and it is my feeling, that I have had for some time, that the National Bureau of Standards has been very fortunate in many respects, particularly in having had since its very foundation a clear legislative mission.

Our organic act has given to our institution a clear sense of direction. To be sure, the particular emphasis given to different aspects of our work changes as national priorities change. These changes in priorities have been brought out each year at these authorization hearings, as well as at other hearings before Congress.

But at no time in the past can I remember the mission of NBS being so much in tune with the times, whether we relate our objectives to the Department of Commerce, to national science policy as stated by the President's science adviser, or to the general sentiment, as we perceive it, in both Houses of Congress.

I refer particularly to assuring the continuing growth and strengthening of our economy, especially through the application of science and technology to our industries. This is a theme that most, if not all, sectors of our society seem to support enthusiastically. For example, the call for cooperation among the various sectors carrying out research and development—universities, industry, and Government—is universal and is being responded to by each of these sectors, not by following some central and rigid prescription, but by groups in different parts of the country getting together voluntarily to cooperate to their mutual advantage.

In this climate, as Director of the National Bureau of Standards I feel excitement, I feel enthusiasm and pride. Our mission is vital and more important than ever before, and not only in our own view but in following the policies of this administration and also of Congress, and in the tangible expressions of support from our users.

The budget that we are presenting to you today contains four major program initiatives. The first is the cold neutron facility. The budget proposal contains a request for $4 million to establish a cold neutron facility adjacent to the NBS reactor by constructing an experimental hall equipped with beam handling tubes that will service 15 experimental stations. This is to be a national research facility and will be a uniquely critical capability to the advancement of materials science in the United States.

Funding for the development of the cold neutron source was provided in fiscal year 1985 for NBS, and the increase that we are requesting is the first of 4 years that would provide the facilities necessary to fully exploit the source. The fiscal year 1986 funds would

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permit us to complete facility design and begin construction of the experimental hall and cold neutron guide tubes.

The second initiative is in process and quality control. In order to remain competitive, industry must increase the efficiency of its operations. This means increased control of manufacturing. This is especially true with the more sophisticated and high value added products, and advances in technology place increased demands on us for measurement services.

And also I would point out, Mr. Chairman, that new measurement services do not often supplant existing ones, and we have an existing responsibility. Thus we are faced with providing additional measurements and standards while continuing to maintain much of our existing array of services.

The $1.9 million we are requesting for process and quality control measurements would increase our level of effort in these areas and fund the development of advanced measurement methods and basic standards sorely needed by industry.

The third initiative is in the area of industrial applications of biotechnology. I would like to quote to you a few words of Dr. Arthur Humphrey, Chairman of the National Academy of Sciences Research Panel on Biotechnology. He said: "We are at war. This war is being waged on the battlefields of high technology commercialization."

Dr. Humphrey and his committee have prepared a detailed and much publicized report identifying the prime areas of research for and principal technical barriers to the commercialization of biotechnology. The stakes are high. Estimates of the world market for biotechnology-related products by the year 2000 range from $50 billion to $70 billion a year.

The Humphrey report has three major conclusions. The chief obstacles to commercialization are likely to be engineering in nature; the United States should substantially increase research leading to new reactor concepts—by reactor, of course, I distinguish this from the previous one I was talking about—and the United States must develop a new class of unit operations for handling macromolecules.

The $3 million NBS is requesting for industrial applications of biotechnology is completely consistent with those conclusions. Our planned efforts in new measurement techniques for compositional determination and the development of data and models for enzyme-catalyzed reactions are pivotal elements to the creation of new reactor concepts.

The fourth initiative is in advanced ceramics. Ceramics offer enormous potential as replacements for a wide variety of existing, more costly materials. These advanced ceramics represent a new generation of materials particularly suited for certain high technology applications. They possess unique properties, especially resistance to corrosion, high temperatures, and wear, and open up a vast array of new applications such as in advanced heat engines, cutting tools, sensors, biomedical devices, and electronic and optical components.

The principal barrier to commercialization of these materials is the inability to control production processes so that ceramic products possess uniform and predictable performance characteristics.

We are requesting $3.5 million to address the measurement problems which make up a large part of that barrier. As with many measurement problems, they are generic in nature and not specific to a given application or segment of the industry.

There are program decreases in the budget presented to you. The NBS Center for Building Technology would be eliminated, for a reduction of $3.1 million. In the last 10 years, the Federal Government has spent $40 million on this program and it is now appropriate for this effort to be assumed by the private sector and State and local governments.

The Federal Automated Data Processing Standards Program in our Institute for Computer Sciences and Technology is proposed to be funded at the $5 million level. This level of funding is consistent with the administration's policy to reduce Federal spending and wherever feasible to transfer activities to the private sector.

The NBS Center for Fire Research would be eliminated, for a reduction of $5.1 million. Again, the Federal Government has invested $50 million in this area in the last 10 years. This research should now be taken over by the private sector and State and local governments.

Our equipment replacement program, which was established in 1976 to provide NBS with an equipment level equivalent to comparable research laboratories, will reach its goal in fiscal year 1985, permitting the 1986 budget to be reduced by $3.3 million.

Related to this item is our working capital fund request, Mr. Chairman, which is a request we are making for our authorization bill to permit NBS to apply any earned net income to replace equipment and inventories. This authority will allow NBS to better allocate the cost of replacing depreciated equipment and inventories. We did request this last year and it was granted by the Congress, but it got caught up in procedures and did not become enacted. So you have seen that before, Mr. Chairman.

Other decreases represent absorptions and reductions for a fiscal year 1986 Federal pay cut of 5 percent, administrative reductions and productivity reviews—that would be a reduction of $3 million—reductions to carry out the Deficit Reduction Act of 1984, a $1.2 million decrease, and absorptions of base adjustments of $2.2 million.

I believe that you have before you a budget that is the result of the administration's careful evaluation of NBS programs and priorities. It is a budget which reflects an appropriate level of resources necessary for NBS to serve industry, Government, and academia at a time when this country is increasingly dependent on science and technology advancement.

NBS is the only Federal agency that supplies the measurement, research, and services, that serve as the vital connection to link tens of billions of dollars of research and development that this Nation spends every year, with the end result of innovation and productivity improvement for the U.S. economy.

We at NBS have done the best job possible with the resources that have been available to us. The country needs new measurement information and services, and we at NBS need to move ahead in some new and important programs. We believe that this budget will permit us to meet the needs of industry in critical areas.

Thank you very much, Mr. Chairman. I would be glad to answer any questions you may have.

Senator GORTON. Thank you, Dr. Ambler. I literally have pages of questions here. The great bulk of them we will submit to you in writing as the Director for your careful written response, so that we can come up with a responsible authorization bill.

I will pick one or two of them, however. The first one has to do with two of your proposed reductions, the Centers for Fire Research and Building Technology. You are perfectly aware that this is not the first year, but the third year, in which the administration has made these twin recommendations.

In both of the last 2 years—and I expect this year will be no different—we have received testimony showing to us that the private sector and State governments are simply not prepared or able to assume responsibility for these services. Have you in these last 2 years, particularly since last year's authorization, made or received any study, documentation, written analysis, et cetera, other than the decision from the Office of Management and Budget, which supports the contention that the private sector and State and local governments can and will perform these services?

Dr. AMBLER. We have worked on that, Mr. Chairman. I know in particular in the fire area we held a workshop—I think it was held in Boston—with all interested parties. And of course, our objective in holding that workshop was to try to persuade them that they should regard it as their responsibility to pick up the funding for these programs.

The result was that they did not agree. So I guess that can be considered a negative result. But we have tried, and I do not think I can bring before you any tangible documentation that I have been able to put together that would be of the kind that you are looking for.

Senator GORTON. Thank you.

Now, in one of your proposed additions, your proposal for advanced ceramics research is for $3.5 million, which includes not only structural ceramics but also electronics ceramics fabrication using chemical processes which do not require the high temperatures needed in conventional processing methods.

Would you tell me from your perspective whether these are quite similar subjects or inherently different ones, and how you will divide the use of that $3.5 million between the two?

Dr. AMBLER. Yes; well, of course, you are quite right that the applications that you mention are very different. I suppose to some extent the basic materials that go into them are different, but the program that we are proposing would serve both. No matter which class of materials you are talking about you come, in each case, to what is the fundamental problem in ceramic processing, the barriers that must be overcome in all areas to really make ceramics do what theoretically they are capable of doing.

And to oversimplify it just a bit, the trouble with ceramics is they crack. They break easily. They have voids and cracks. And what we must do is in the processing stage, to construct them in such a way that they do not have these cracks or, if they do, the cracks are so small that they are irrelevant.

That has to do with understanding what goes in in ceramics at the atomic level. It has to do with the movement of atoms and the structure, the crystalline structure, and the different phases there. It is a very basic thing in all of ceramics, to improvement of all ceramics, that has to be looked into. There is a lot of data and information that currently just does not exist.

So what we would do would serve both areas equally in my judgment.

Senator GORTON. You are requesting about $8 million to construct a cold neutron research facility adjacent to the Bureau's reactor. Can you tell me what your schedule for its operation is, and what kind of future funding requests there will be for it in the foreseeable future?

Dr. AMBLER. Yes; as I think I said in my testimony, this is the first request of a four-year request for appropriations. I do not remember the exact figures for the out years. I guess those will have to be worked out. But it is roughly the same.

Senator GORTON. Will it take the entire 4 years to get into operation?

Dr. AMBLER. Yes, it will, sir. But as you can imagine, there is a lot of work to do and we can be getting on with it because—well, first of all, this facility has got to be suitably screened and made safe, the guide tubes developed, and the instrumentation designed. So there is plenty that we can be doing.

But before it is fully operational, yes, it will be 4 years.

Senator GORTON. As I said, doctor, I have a multitude of additional questions which we will submit in writing. With the large number of witnesses, I will conclude my oral questioning now.

The ranking member, Senator Riegle, is here and I would be happy to give him a chance for an opening statement or for questions.

Senator RIEGLE. Mr. Chairman, I will not make a statement at this time. I will review carefully the testimony that has just been presented, and I will have questions to submit for the record.

Senator GORTON. Doctor, you got off easy this morning, but you are going to have a lot to answer in the next few weeks. Thank you very much.

Dr. AMBLER. Thank you very much.

[The statement follows:]

STATEMENT OF DR. ERNEST AMBLER, DIRECTOR, NATIONAL BUREAU OF STANDARDS, DEPARTMENT OF COMMERCE

I am pleased to appear before you today to request authorization of appropriations for the programs and activities of the National Bureau of Standards (NBS) in fiscal year 1986.

Accompanying me is the Deputy Director of NBS, Mr. Raymond G. Kammer.

I will summarize our authorization request of $120 million for fiscal year 1986.

The National Bureau of Standards has been fortunate in my view, in having had, since its foundation, a clear legislated mission. Our Organic Act has given to our institution and to us as managers a direction and has provided a sound basis for discussion of our programs especially with this subcommittee.

To be sure, the particular emphasis given to different aspects of our work changes as national priorities change. These changes in priorities have been brought out each year at these Authorization Hearings as well as at other hearings before Congress. But at no time in the past can I remember the mission of NBS being so much in tune with the times, whether we relate our work to the objectives of the Depart-

ment of Commerce, to national science policy as stated by the President's Science Advisor, or to the general sentiment, as we perceive it, in both Houses of Congress.

I refer particularly to assuring the continuing growth and strengthening of our economy, especially through the application of science and technology to our industries. This is a theme that most, if not all, sectors of our society seem to support enthusiastically. To be sure, there are some differences of opinion about the appropriate role for the Federal Government relative to the responsibilities of others, but there are more agreements than differences and such differences as may remain seem to me to be facing rapidly. For example, the call for cooperation among the various sectors carrying out research and development—universities, industry, and government—is universal and is being responded to by each of these sectors; not by following some central and rigid prescription, but by groups in different parts of the country getting together voluntarily to cooperate to their mutual advantage. I find our own experience both heartening and impressive.

Our interactions with industrial measurement users have always been strong, and they are growing stronger. For example, over the past four years, we have increased participation in our Industrial Researcher Associate Program by more than 60 percent. We now have in excess of 150 researchers from private companies and other institutions working at NBS on areas of mutual interest—with their sponsors, not NBS, paying their salaries. Our guest worker program is up by more than 40 percent, to 523 researchers working at NBS. The dollar value from measurement calibration services we provide is up 70 percent, and the dollar volume for sales of our standard reference materials is up 47 percent from 1980

Most dramatically, the estimated value of cost-sharing and assistance-in-kind by those who are interested in and need NBS researcher and services has almost trebled over the past four years. That is a concrete measure of the value of NBS' work.

Another important indicator is the Report of the White House Science Council Federal Laboratory Review Panel (Packard Report). There is a very high level of interest in focusing our national R&D effort, and this report is just one expression of that interest.

In this climate, as Director of the National Bureau of Standards, I feel excitement, enthusiasm, and pride. Our mission is vital and more important than ever before, not only in our own view but in following the policies of this Administration and also of Congress and in the tangible expressions of support from our users.

The NBS role of providing accurate, reliable, scientific, and engineering measurements and data is one I do not need to belabor before this Committee. It is difficult to explain in a few words the range of disciplines we must cover in the physical sciences and engineering and equally difficult to enumerate the range of users of our services.

Permit me to give you just one set of facts that I find persuasive; those which identify the economic importance of NBS measurement services.

Measurements are important in most segments of the U.S. economy, but particularly so in those industries where the application of science and engineering are producing very high growth rates. Across the whole of the Nation's economy $163 billion was spent on measurements in 1983, which is 3.5 percent of the GNP. Nearly half of that total is concentrated in 20 sectors including such fields as electronic components where 20 percent of that industry's labor costs are for measurements. Industry requires a sound system upon which to base measurements which are vital to the research upon which new products are developed, to the assurance of quality and efficiency in manufacturing operations, and to the maintenance of equity in trade. Working with industry, NBS plays the central role in developing the basis to which all these measurements are referred.

We derive a great amount of satisfaction from the role we play in this cooperative enterprise with the private sector which in its comprehensiveness fills society's needs and assures the accuracy and objectivity necessary for public confidence.

So even as we deal with very difficult budget decisions and quite apart from those specific proposals, I hope I have been able to convey to you why I feel so positive and upbeat about NBS as a national laboratory, particularly at this time.

The budget that we are presenting to you today contains four major program initiatives. I will review them for you.

The fiscal year 1986 budget proposal contains a request of $8 million to establish a Cold Neutron Research Facility adjacent to the NBS reactor by constructing an experimental hall equipped with beam handling tubes that will service 15 experimental stations. This national research facility will be a unique capability critical to the advancement of materials science in the United States. The country faces severe materials challenges in developing advanced materials such as ceramics, composites and polymers, for use in communications, electronics, aerospace, medicine, biomolec-

ular engineering, and other fields. In all of these areas, cold neutron beams will be an invaluable research tool. This fact has been recognized by a high level committee of the National Academy of Sciences as the single most important resource for solving these problems now and in the near-term future. Cold neutron experimental facilities, which were specifically endorsed by them and given highest priority for additions to existing facilities, will provide intense beams of long wavelength neutrons that are able to make key measurements of the internal structure of a wide range of materials.

The United States does not have a facility like the one in Grenoble, France, where more than $140 million has been invested in cold neutron facilities. A facility like the one proposed at NBS is not feasible for the private sector because of the capital investment required for a research reactor and environmental constraints on the construction. The NBS reactor already has the capability to produce the cold neutrons and is the only research reactor in this country which will allow the installation of a cold neutron source large enough to handle the array of instruments and work stations which U.S. researchers need.

Funding for the development of the cold neutron source itself was provided in the fiscal year 1985 budget for NBS. The increase we are requesting, the first of four years, would provide facilities necessary to fully exploit this source. The fiscal year 1986 funds would permit us to complete facility design and begin construction of the experimental hall and cold neutron guides. The plans for this world class facility include four new beam ports to support 15 experimental stations. Four of the experimental stations are expressly designated for industrial users. Since our aim is to operate a truly National Facility, clearly the early operation of the experimental stations available to the private sector are a very high priority.

Earlier, I mentioned that the mission of NBS is very much in tune with the times. Nowhere is this clearer than in our function to provide measurement services in the physical sciences. In order to remain competitive, industry must increase the efficiency of its manufacturing operations. This is especially true with the more sophisticated and higher value-added products. Advances in technology place increased demands on NBS measurement services, since new measurement services do not always supplant our more traditional ones. Thus, we are faced wih providing additional measurements and standards while continuing to maintain much of our existing array of services. We are requesting $1.9 million for Process and Quality Control Measurements which would increase our level of effort in these area and fund the development of advanced measurement methods and basic standards sorely needed by industry. The new services would be in areas such as spectroradiometry, impedance, and microwave measurements, all of which have been identified by industry as top priorities.

Clearly as manufacturing technology becomes more complex, as automation increases, and as quality contol becomes an integral part of the manufacturing process itself, the role played by measurement becomes more crucial. The Process and Quality Control initiative will allow industry to move forward and meet the competition.

Please allow me to quote you a few words of Dr. Arthur Humphrey, Chairman of the National Academy of Sciences Reseaarch Panel on Biotechnology. "We are at war! An economic war . . . is being waged on the battlefields of high-technology commercialization."

He and his Committee have prepared a detailed and much publicized report identifying the prime areas of research for and principle technical barriers to the commercialization of biotechnology. The stakes are high! Estimates of the world market for biotechnology-related products by the year 2000 range from $40 to $70 billion/year. The Humphrey Report, published by the National Academy of Sciences at the end of 1984, has three major conclusions: the chief obstacles to commercialization are likely to be engineering in nature; U.S. should substantially increase research leading to new reactor concepts; and, we must develop a new class of unit operations for handling macromolecules. The $3 million NBS request for Industrial Applications of Biotechnology is completely consistent with those three conclusions. Our planned efforts in new measurement techniques for compositional determination and the development of data and models for enzyme-catalyzed reactions are pivotal elements to the creation of new reactor concepts.

We also plan work on biologically-compatible sensors and separation measurements which are essential to the development of the new class of chemical engineering unit operations needed to handle macromolecular structures. Generic research of the type NBS would support is needed by virtually all companies, yet is too expensive to be undertaken by individual firms, particularly the many small firms which comprise this industry. Our research will be conducted in collaboration with

other government agencies, industry, and universities in order to take advantage of the biological expertise of those organizations and to ensure timely and effective transfer of NBS-developed results to those organizations needing them.

As the Subcommittee directed last year, NBS developed a plan on a national effort in measurements and standards for the biotechnology industry and related industries. Our report, "A National Program of Measurement Services and Standards for Biotechnology at the National Bureau of Standards," has been delivered to the Subcommittee.

Ceramics offer enormous potential as replacements for a wide variety of existing, more costly materials. These Advanced Ceramics represent a new generation of materials particularly suited for certain high technology and related applications. These ceramics possess unique properties, especially resistance to corrosion, high temperatures, and wear which open up a vast array of new applications such as in advanced heat engines, cutting tools, sensors, biomedical devices, and electronic and optical components. The principal barrier to commercialization of these materials is the inability to control production processes so that ceramic products possess uniform and predictable performance characteristics. We are requesting $3.5 million to address the measurement problems which make up a large part of that barrier. As with many measurement problems, these are generic in nature and not specific to a given application or segment of the industry.

The NBS effort will focus on the measurement services required to control the microcracks which form in ceramics and which are the cause of unreliable performance. U.S. industry is facing stiff competition in this area, with Japan already dominating ceramics for electronic components, controlling 50% of the $4.1 billion world market. At stake for the country are not just the industries which produce the advanced ceramics, but also the myriad of industries which will use ceramics in manufacturing their own products. Rapid growth is expected in ceramics with sales reaching $19 billion/year a decade from now. It is clear that one of the keys to industrial success in the future is the ability to be versatile and innovative in materials science and engineering. Advanced ceramics is a good example of a field in which our Nation's industry must move ahead, and this NBS program will go a long way toward establishing the measurement base required for that movement.

There is one other increase in our fiscal year 1986 proposal of $4.9 million, which includes adjustments for next year's costs of the fiscal year 1985 pay increase, and other increases and decreases for personnel and vital services.

I am extremely pleased to report to this Subcommittee on the status of the Class VI supercomputer procurement. A contract was signed with Control Data Corporation on September 28, 1984 for a Cyber 205 with Cyber 855 front end. Installation of the hardware, which arrived on February 25, 1985, is proceeding on schedule. Acceptance testing is scheduled to begin on April 1, 1985. The CDC bid of $7.2 million was extremely favorable to NBS and is well below what we had expected.

There are program decreases in the budget presented to you. The NBS Center for Building Technology would be eliminated (−$3.1 million). In the last 10 years, the Federal government has spent $40 million on this program. It is now appropriate for this effort to be assumed by the private sector and state and local governments. The Federal automated data processing, or ADP, standards program in our Institute for Computer Sciences and Technology (ICST) is proposed to be funded at $5 million. ICST will concentrate on international networking of computers while voluntary standards organizations would be relied upon for the majority of computer-related Federal standards. The NBS Center for Fire Research would be eliminated (−$5.1 million). Again, the Federal government has invested $50 million in this area in the last years. This research should now be taken over by the private sector and state and local governments.

Our equipment replacement program, which was established in 1976 to provide NBS with an equipment level equivalent to comparable research laboratories, will reach its goal in fiscal year 1985, permitting the fiscal year 1986 budget to be reduced by $3.3 million with minimal program impact.

Other decreases represent absorptions and reductions for a fiscal year 1986 Federal pay cut 5 percent ($2.4 million), administrative services reductions and productivity reviews ($3.0 million), reductions to carry out the deficit Reduction Act of 1984 ($1.2 million), and absorptions of base adjustments ($2.2 million).

In summary, I believe that you have before you a budget that is the result of the Administration's careful evaluation of NBS programs and priorities. It is a budget which reflects an appropriate level of resources necessary for NBS to serve industry, government, and academia at a time when this country is increasingly dependent on science and technology advancement while facing massive Federal deficits. NBS is the only Federal agency that supplies the measurement research and services

that serve as the vital connection to link the tens of billions of dollars of research and development that this Nation spends every year with the end result of innovation and productivity improvement for the U.S. economy.

We at NBS have done the best job possible with the resources that have been available to us. The country needs new measurement information and services, and we at NBS need to move ahead in some new and important programs. We believe that this budget will permit us to meet the needs of industry in critical areas, and I urge the Committee to support this budget.

Thank you, Mr. Chairman and Members. I will be pleased to answer any questions you may have.

[The following information was subsequently received for the record:]

Questions of Senator Gorton and the Answers

Center for Fire Research/Center for Building Technology

Question. Dr. Ambler, many Federal regulatory agencies rely on the technical support provided by these Centers. For example, research performed by the Center for Building Technology was used by the Occupational Safety & Health Administration (OSHA) to revise construction safety regulations designed to prevent excavation cave-ins at construction sites. Likewise, research performed by the Center for Fire Research was used by the Consumer Product Safety Commission (CPSC) to generate a flame-retardant standard for children's sleepwear. If these Centers are eliminated, who can the Federal regulatory agencies rely on for objective, neutral research data?

Answer. CFR and CBT do contract work for other Federal agencies, but it is the position of the Administration that the work of CFR and CBT can best be handled by the organizations which have sought the services from NBS, be they Federal, state, local governments or the private sector.

Question. The objectivity of the Center for Building Technology is important when the Bureau is called upon to investigate major structural collapses. For example, the Center's analyses of the Kansas City, Missouri, Hyatt Regency skywalk collapse in 1981 and the East Chicago, Indiana, highway ramp collapse in 1982 provided valuable information to organizations that write building codes and standards. If this Center is eliminated, who can provide an unbiased view of such disasters, that is a viewpoint that is not prepared for litigation?

Who can assure that the valuable results of such investigations are distributed nationally to building code organizations?

Answer. There is obviously no incentive for any private sector firm, university, state or local government or association thereof to indicate a firm commitment to assume any or all of the responsibilities of CBT or CFR as long as U.S. taxpayers subsidize this work. The Federal Government should still, however, withdraw from areas in which state and local government have unchallenged responsibility, particularly when Federal Government is facing dramatic deficits and state and local governments are experiencing budget surpluses. The construction and insurance industries in cooperation with state and local building authorities can and should support this research, perhaps even through the National Conference of State on Building Codes and Standards which can require the dissemination of research findings for the public interest and safety.

Question. The Center for Fire Research provides $2 million annually for fire research programs in universities and research institutions. If this flow of funds stops, how much university-based basic fire research will continue?

Answer. It is dificult to answer this question, but a small amount of fire related research is conducted through funding from the National Science Foundation which can be expected to continue.

Question. If the Center for Building Technology were terminated, what would happen to earthquake research, for example, the development of seismic design and construction provisions, at the Center?

Has any other agency, or have state governments indicated a willingness and ability to perform that research?

Are any special facilities needed to perform it? If so, how much would it cost to replace the facilities?

Answer. We have no plans to conduct earthquake related research other than what is described in the National Earthquake Hazard Reduction Program report recently submitted to congress.

We have no new information regarding willingness to do the work by other organizations. There is obviously no incentive for any private sector firm, university, state or local government or association thereof to indicate a firm commitment to assume any or all of the responsibilities of CBT or CFR as long as U.S. taxpayers subsidize this work. The Federal Government should still, however, withdraw from areas in which state and local government have unchallenged responsibility, particularly when Federal Government is facing dramatic deficits and state and local governments are experiencing budget surpluses. The construction and insurance industries in cooperation with state and local building authorities can and should support this research, perhaps even through the National Conference of States on Building Codes and Standards which can require the dissemination of research findings for the public interest and safety.

Special facilities are required to perform the earthquake research. While detailed figures are not available we would estimate the cost of replacement of the NBS facilities and equipment at approximately $5 to $10 million.

Question. Did the Bureau and the Department of Commerce request full funding for the Centers for Fire Research and Building Technology from the Office of Management and Budget (OMB)?

Answer. Yes. Initially, the Department requested full funding, however, the Department did not appeal OMB's decision to eliminate the funding for CBT and CFR.

GS 11–15 FREEZE

Question. How will the Bureau implement the GS 11–15 freeze?

Answer. NBS is implementing the reduction through filling only two out of every three vacancies in the GS 11–15 range.

Question. Please provide the committee with the following:

a. the number of employees in pay grades 11–15;

b. the percentage of employees in pay grade 11–15 who hold technical positions;

c. the turnover or separation rate of technical employees in pay grades 11–15. The separation rate of non-technical GS 11–15 employees.

Answer. There were 1501 employees in pay grades 11–15 at the end of fiscal year 1984. Of the employees in pay grades 11–15, 81 percent hold scientific and technical positions. The separation rate of technical employees in this grade range is 5 percent; the separation rate of non-technical GS 11–15 employees is 8 percent.

INSTITUTE FOR COMPUTER SCIENCES AND TECHNOLOGY (ICST)

Question. Dr. Amber, you mention in your testimony that if the Institute for Computer Science and Technology is funded at $5 million, the Bureau will rely upon voluntary standards organizations for the majority of computer-related Federal standards.

Is there a specific organization in the private sector that will be able to take the lead in coordinating and communicating with Federal agencies to determine the need for Federal standards and guidelines?

Answer. We are unaware of a particular private sector organization that would fulfill this specific role at this time.

Question. Will reliance on voluntary standards-making organizations, such as the American National Standards Institute (ANSI) lead to substantial delays in establishing standards?

Answer. There are various reasons why standards organizations proceed slowly both with and without Federal Government involvement in the form of technical support. It is possible that fewer standards may be developed than would otherwise occur. There also exists a likelihood that more agencies may develop their own standards and that a degree of incompatibility may be a consequence.

Question. What program or areas of research will be negatively affected or eliminated if the $5 million cut is approved?

Will the Institute continue its support for the Paperwork Reduction Act of 1980? If not, how will the Director of the Office of Management and Budget (OMB) fulfill the tasks assigned by the Paperwork Reduction Act?

Answer. The loss of $5 million will confine ICST's activities to a reduced program in the area of international networking standards. All other work will be terminated.

Question. Dr. Amber, cost benefit studies prepared under contract for the National Bureau of Standards indicate that the estimated benefits to the government resulting from the use of Federal information processing standards greatly exceed the cost of standards development by the Institute. For example, analysts estimate the government saved more than $70 million by adopting a new standard the Bureau

developed for a programming language called COBOL. Considering such statistics, does the cut in funding conflict with the Administration's goals set forth in the Office of Management and Budget's "Management for Fiscal Year 1986" report which requires Federal agencies to obtain a minimum of 10% return on investment for all computer technology and to cut software maintenance costs by 25%?

Answer. Cost benefit analyses indicate savings as a result of standards development and use. Budget priorities for NBS were formulated with particular concern for areas where the Federal Government may be undertaking efforts that are more properly the role of the private sector and state and local governments. Moreover, individual agencies can take the responsibility of insuring returns on their investment and reducing their software maintenance costs.

Question. Did the Bureau and the Department of Commerce request full funding for the Institute for Computer Sciences and Technology from the Office of Management and Budget (OPM)?

Answer. Yes. However, the Department did not appeal OMB's recommendation to reduce funding for ICST.

BIOTECHNOLOGY

Dr. Ambler, let's turn now to the four substantive new initiatives, beginning with biotechnology. The Committee has reviewed your report, "A National Program of Measurement Services and Standards for Biotechnology at the National Bureau of Standards," and we have some questions concerning it.

Question. Most of the program objectives in section IV of the Bureau's proposal seem to be basic research topics; the National Science Foundation (NSF) currently funds these types of projects. For example, programs at the National Science Foundation, the National Institutes of Health, and in industry are studying protein structure and function. Is the Bureau the proper place for this type of basic research?

Answer. The research performed by NBS supports the development of a quantitative foundation for measurement. This foundation is the critical element needed for a national system of measurement, ensuring compatibility in commerce, trade, technological development, and proper functioning of a voluntary standards system. Measurement services developed by NBS are a critical part of this foundation. Aspects of NBS's measurement research are basic, but build upon and do not duplicate research performed at NIH or supported by NSF. Moreover, neither NIH, NSF, nor any other institutions, public or private, have the responsibility or inclination to harmonize measurement in the U.S. (See also answer to question below.)

Question. A number of laboratories across the country are working on each of the program objectives mentioned in section IV of the Bureau's proposal. Will the Bureau's biotechnology program duplicate these research projects which are already being funded, for the most part, by NSF and industry?

Answer. There are in fact no other laboratories in the U.S. working on the measurement-service objectives mentioned in section IV of the Bureau's proposal. The combination of a quantitative foundation for measurement, provision of services for ensuring compatibility of measurement, and leadership in voluntary standards development is unique to NBS. In developing measurement services, NBS draws upon the expertise of other laboratories. It does so in an aggressively interactive mode, actively soliciting cooperation and communication with other organizations. Visiting scientist programs, hosting of workshops and symposia, and participation in voluntary standards and professional organizations are among the many ways that NBS derives support from and provides services to the technological and scientific communities. Each year a typical organizational unit at NBS (about 120 scientists) interacts with several thousand counterparts from industry, universities and government.

Question. Many of the Bureau's program objectives have been areas of concentration for chemical and biochemical engineers and the fermentation industry for the past 30 to 40 years. Why weren't standards required from the Bureau much earlier by university researchers and industry? Has the recent addition of genetic engineering to industry's research techniques now made it necessary for the Bureau to develop standardized measurements and standard reference materials for the biotechnology industry?

Are these services required by the biotechnology industry now or in the near future?

Answer. Measurement standardization is critical in the commercialization phase of technological development because it is in this stage when compatibility is needed for trade (buyer-seller agreements), quality assurance (raw materials purity, product purity, product consistency), and for a variety of other applications, less important

during research and development. NBS timing in biotechnology mirrors that in other technologies where NBS now provides key measurement services and supports the development of voluntary standards. Biotechnology is currently affecting a number of industries, including chemicals, pharmaceuticals, health (care), food processing, and agriculture, and the number of commercial processes incorporating biotechnology is expected to increase dramatically in this decade. Recent growth in genetic engineering applications with products nearing introduction, demands, for the first time, a system of measurement since it's only now that many parties must come together to compare results of measurement. Typically, such comparisons will reveal differences too large to be acceptable for use in trade or quality assurance. Among the leading technology areas, biotechnology will be more dependent upon measurement and more demanding owing to measurement complexity.

Question. What are the measurement problems that presently universities and industry are unable to perform? Why are these measurements difficult to achieve? How will the Bureau commit resources to perform those tasks that industry and universities are unable to handle?

Answer. Universities and industry are not developing a measurement system for the U.S. Thus, they are not addressing method intercomparison, compatibility, or services to ensure the basis for a "weights and measures" system. Specific problems encountered include: (a) disagreement among methods purportedly measuring the same quantities; (b) day-to-day and laboratory-to-laboratory variability in results; (c) lack of ability to measure reliably at low concentrations; (d) lack of key data. These problems are difficult to solve because they require: (a) specialization in measurement; and (b) special facilities for thorough investigation of error; (c) ability and organizational apparatus to produce measurement services, and to have these services recognized worldwide. NBS will commit resources in a manner paralleling its approach in support of other technological areas, methods development, standards development, voluntary standards participation, etc. In doing so, we will cooperate with universities and industries and draw upon their resources where appropriate.

Question. Section IV of the Bureau's proposal lists numerous (19) "near-term measurement objectives." Is the Bureau being realistic in its expectation of studying this large number of projects, or should the Bureau attempt to be more focused?

Answer. Yes, we believe this is a realistic and focused assessment. The FY 86 budget request will allow NBS to add the needed expertise (e.g. biochemists, microbiologists, engineers) to our staff and to perform measurement research in three industrially significant areas: (1) enzyme catalysis; (2) separation processes for biomolecules, and (3) the use of biomolecules in chemical analysis and measurement quality assurance.

Question. The request this year is for $3 million. Can you give us an idea of what the likely requests would be over the next several years?

Answer. The steady state operating level of this program is $3 million.

Question. Does the Bureau have any special or unique services, equipment, or personnel expertise to offer at this time to the biotechnology industry?

Answer. NBS is world renowned for its expertise in physical and chemical measurements and has a long history of developing measurement methods, standards, and data for evolving technologies. Commercialization of biotechnology will be very dependent on chemical and physical measurement technology. NBS's expertise in technical areas such as: x-ray and neutron diffraction; electrophoresis; molecular spectroscopy; chromatography; thermodynamic properties; and the use of its unique facilities such as the NBS Reactor and analytical laboratories are already being applied to measurement problems related to the biotechnology industry.

ADVANCED CERAMICS

Question. In addition to the need to be able to produce ceramic parts reliably, successful use of ceramics could also involve various design changes needed to prevent stress concentrations that can lead to catastrophic failure. To what extent will the Bureau's initiative address generic aspects of these design considerations?

Answer. The objective of the advanced ceramic initiative is to understand and measure the origin and fate of defects that affect reliability in manufacture and performance in service. Since defects and their behavior establish property characteristics and limits (e.g. strengths) the NBS program will provide the generic basis from which general design criteria can be formulated by the design engineer. The program however, will not involve design methodology or design modifications per se, as these are application specific.

Question. A key part of the proposed ceramics initiatives is measurement and characterization of the appropriate microstructural features. To what extent will

the success of this initiative depend on the availability of a cold neutron source to measure and characterize microstructure?

Answer. Advance ceramic research requires a wide array of instruments and facilities. For example, scanning and transmission electron microscopes, automated x-ray diffractometers, mechanical properties testing stations, controlled atmosphere furnaces, particle size counters, and ultraviolet, visible, and infrared spectrometers will be utilized daily. The existing NBS Research Reactor, with its small angle neutron spectrometer as one example, is another existing key facility for the proposed research in advanced ceramics. Likewise, the new NBS scientific computer will greatly expand the capability to develop predictive models as well as to analyze complex data.

The construction of the Cold Neutron Research Facility will significantly expand the array of characterization tools and provide several unique capabilities that will clearly benefit the Advanced Ceramics program and the U.S. ceramics industry. Yet no one resource is critical itself. Providing NBS services to industry, government and academia will require utilization of all our equipment resources.

Question. How will decisions be made about which problems will be tackled? Will immediate industrial need or scientific merit be given priority?

Answer. The advanced ceramics program will focus on the development of measurement methods, certification of ceramic reference materials, and evaluation of critical data. All of these NBS services are directed towards the solution of industrial problems that inhibit reliable and reproducible production of advanced ceramics. The principal feature will be the understanding of flaws, determination of what step in processing and use that they originate, predicting how they affect properties, and providing data and reference materials needed by industry for reliable manufacture. Data evaluation efforts will be directed into areas of greatest industrial need through collaboration with industrial societies and trade organizations. For example, the existing ceramic phase diagram and the x-ray powder diffraction reference data programs are collaborative efforts involving Industrial Research Associates supported by their professional society. In each program, there is a yearly review and reassessment of the user community's needs. In other areas, such as fine-particle, ultra-high-purity synthesis, there is a balanced need for research and creativeness. This research will focus on improved measurement methodologies for accurate powder characterization, developing predictive models for compaction and sintering, and correlation of features and properties of ceramic products.

Question. Dr. Ambler, can you elaborate on the kind of cooperative programs that will be undertaken with this initiative? For example, are there other research labs looking at these problems and, if so, how will you interact with them? What type of support do you expect to receive from industry?

Answer. The advanced ceramics program has been developed with input from industry, academia, the American Ceramic Society, and other Federal agencies. NBS has already established collaborative arrangements with several university-industry consortia (MIT and Rutgers) and has received significant encouragement from the DOE laboratories. Industry is also supportive of this program and has begun collaboration with NBS through the Guest Worker and Industrial Research Associate programs. In all cases, it is clearly recognized that NBS has a unique technical responsibility to fill. In particular, these groups look for NBS to fill the need for measurement methods, evaluated data, and reference materials—all of which are essential infratechnology required by industry for rapid proprietary development. We expect the cooperative programs between NBS and the university-industry consortia, professional societies, and other government laboratories to expand under the Advanced Ceramics program.

COLD NEUTRONS

Question. Dr. Ambler, what will be the request for future funding over the next four years?

Answer. The $8 million request is for the first year of a four-year, $25 million facility construction program. This facility will be constructed adjacent to the NBS research reactor building. Four large beam tubes will guide the cold neutrons from the cold source, through the reactor building wall into the facility building. Fifteen experimental stations will be positioned along the tubes. In addition, $3 million will be required at the steady state operating level (FY 1990).

The NBS proposal represents the most cost effective and expeditious way to provide this critical research tool to the Nation. Construction costs in Europe for cold neutron research, where measurement capabilities have existed for a decade, exceed $140 million. Great Britain paid $50 million to buy into the European effort in cold

neutrons and now pays $10 million annually to participate in this European effort, as do France and Germany. The Japanese have announced a program to build a cold neutron facility at a cost in excess of $150 million of which $50 million is directly for cold neutron research. To build a new high-flux research reactor in the U.S. to match the NBS cold neutron capability would cost well over $100 million and would require over 10 years to complete.

Question. Would the cold neutron research facility provide any research opportunities in technologies that are important to maintaining U.S. international competitiveness in certain strategic industries?

Answer. Cold neutron research has been identified by a very recent National Academy study as the number 1 priority for expansion of existing major materials research facilities. The evaluation criteria strongly weighed the impact on industrial innovation and competitiveness. No such U.S. facilities exist nor is private sector development practical. The best European facilities are oversubscribed by the member nations and, therefore, their use by U.S. industry is precluded.

The applications of cold neutrons to materials characterization cut across our industrial economy. For example, cold neutrons will enable unique characterizations of precipitates and magnetic ordering which are of crucial importance to the development and effectiveness of both basic alloys (steel, aluminum) and new high-technology alloys produced by U.S. metals industries. As another example, the chemical industries will be able to measure molecular arrangements and processes which determine the performance of catalysts in chemical production and purification and provide key information for the development of advanced catalysts to keep us internationally competitive. Equally critical research on advanced ceramics, bioenzymes, new classes of semiconductor materials, polymer blends and composites would also be opened up by the world-class Cold Neutron Research Facility provided by this initiative.

Question. Have any industries expressed interest in having access to results of NBS cold neutron research or to the facility provided as part of this project? Would the Bureau grant such access if there were interest?

Answer. Broad and enthusiastic industrial support for collaborative research on experimental stations at the NBS Cold Neutron Research Facility has been received from major chemical (DuPont, Exxon, Eastman Kodak), advanced materials (Allied, AT&T, Alcoa), computer and communications (Intel, Motorola, GTE, IBM), and the aerospace and transportation industries (G.E., Rockwell International). Several private sector organizations have indicated a strong interest in forming Participating Research Teams. Each Team would fund the design and construction of a specialized research station at the Facility to meet their particular research needs. Up to one-third of the research stations are reserved for such Teams, who will in turn provide one-third of the time on the stations they develop to the U.S. scientific community.

NBS has a successful history at stimulating productive cooperative research ventures with industries as evidenced by current collaborative industry-NBS research within the Center for Material Science (CMS). Today there are 61 Industrial Research Associates supported by industry who work nearly full time in CMS. In addition, in 1984 over 180 guest workers joined CMS staff to perform research of mutual interest. This existing framework would be the foundation of greatly expanded industry/industry cooperation in research at the Cold Neutron Research Facility.

Question. Do you anticipate having any cooperative research projects with universities?

Answer. The NBS research reactor already has some 70 professors and students as guest workers from 30 universities around the U.S. and many more engaged in cooperative research. With the addition of the Cold Neutron Research Facility, this level of cooperative research will expand many fold due to the unique measurement capabilities being planned. As an example of the expected university interest, NBS has already been approached informally by a consortium of universities (University of Washington, University of Maryland, Harvard, and University of Missouri) interested in developing one of the special research stations.

PROCESS AND QUALITY CONTROL

Question. Dr. Ambler, the Bureau is requesting $1.9 million for Process and Quality Control Measurements. Your budget justification states that the process quality control initiative was "identified by national organizations and endorsed by a panel of industrial and government experts."

(a) What are these organizations?

(b) Who are the industrial and government experts?

Answer. The organizations involved in identifying the needs outlined in the process and quality control initiative are the National Conference of Standards Laboratories, the Council for Optical Radiation Measurements, and the Conference of Radiation Control Programs Directors. In addition, input was obtained through requests from professional societies and trade organizations, workshops and studies, and industrial laboratory visits.

The outside review panel for the process and quality control initiative consisted of the following:

Jerry Hayes, Navy Metrology Engineering Center; Laurel Auxier, Beckman Instruments (now with Science Applications International Corporation); Dean Brungart, Teledyne Systems; George Rice, Rockwell International; Robert Weber, Lockheed Missiles and Space; William Partlow, Westinghouse R&D Center; Franc Grum, Eastman Kodak (now with Rochester Institute of Technology); Delbert Caldwell, Navy Metrology Engineering Center, Chairman, NCSL Requirements Committee; Roger Schneider, Bureau of Radiological Health.

Question. Your budget justification states that the Defense Department is among the user groups which need this initiative. To what extent will the Defense Department help to defray the cost of, or pay for, this work?

Answer. The projects included in the process and quality control initiative will primarily impact the more generic needs of a broad base of industry, although DOD will also ultimately benefit from the outputs of the program. While DOD does not plan to contribute directly to the support of the initiative, they have contributed approximately $800,000 for related metrology research during the past year. The specific Defense Department needs are being addressed in a DOD initiative (Calibration Group Engineering Projects) related to specific weapons, communications, and control systems, which will require NBS expertise for technology development.

Question. Your budget justification states that this initiative will aid industries which are at the "forefront of our international competitiveness." Specifically, which industries will benefit most from this research?

Answer. The $1.9 million would fund the development of advanced measurement methods and basic standards in the areas of spectroradiometry, impedence, and microwave measurements. Industries which will benefit from measurement research in these areas include electronics, communications, lighting, defense, and aerospace. The spectroradiometry project will allow NBS to implement a new approach to radiometric calibrations based on solid state detectors in addition to traditional lamp standards. This new approach is essential for reliable measurements in the lighting, photographic, and electro-optics industries. The electrical impedence project will provide new automated capacitance and inductance calibration systems with extended ranges and a new calibration service for dissipation factor measurements, which will impact precision electronic instrument manufacturers and electrical component manufacturers. The microwave measurement project will provide new methods and standards for microwave measurements such as microwave power, attenuation, reflection coefficient, and noise in the frequency range used in advanced communications and aerospace systems.

Questions of Senator Riegle and the Answers

NBS and Industrial Competitiveness

Question. Dr. Ambler, recently the President's Commission on Industrial Competitiveness (the Young Commission) made these comments about American manufacturing:

"Manufacturing technology needs more emphasis. Perhaps the most glaring deficiency in America's technological capabilities has been our failure to devote enough attention to manufacturing or 'process' technology. It does us little good to design state-of-the-art products, if within a short time our foreign competitors can manufacture them more cheaply. The United States has failed to apply its technologies to manufacturing. Robotics, automation, and statistical quality control were all first developed in the United States, but in recent years they have been more effectively applied elsewhere."

From your perspective, how much does the United States lag behind Japan and others in manufacturing processes and in our ability to make high-quality, low-cost goods? What research needs to be done to make American factories competitive again? How is the Bureau of Standards working with industry to improve our manufacturing technology?

Answer. The National Bureau of Standards fills a specific, critical niche in helping U.S. industry produce high-quality, low-cost, internationally competitive goods. NBS works very closely with industry to make sure that essential measurement science and technology is available to meet industry's needs. Measurement technologies make it easier for industrial scientists and engineers to transform general technical principles into new processes and new product technologies. Measurements and measurement methods are crucial to quality assurance and the control of industrial processes. Measurement technologies also help markets grow. A certain level of risk accompanies high technology products to market. Test methods, test structures, and industry standards help new technologies "diffuse" or get into wider use faster by reducing risk or uncertainty. Measurement science and technology is a vital link in the U.S. economy.

I do not believe that the Japanese have succeeded in attaining a technological lead over the U.S., but they have mastered the organization and management of production. They focus on manufacturing efficiency—the combined effect of technology and the ability to organize and use it and squeeze the maximum productivity out of a given level of technology. U.S. industry has made significant strides in production management also, so the "gap" is now fairly narrow. Over the next decade, however, I believe that competitive advantage will be based more on technology development than on its management and organization. The manufacturing technologies of the next decades will be integrated systems technologies that are inherently complex (including complicated measurements). The competitiveness of U.S. industry will depend on fast diffusion of these new production technologies.

Modern production depends heavily on measurement. Industrial engineers use engineering data and measurement methods to control production processes. Quality assurance engineers use data, standard reference materials, equipment calibration, and test methods to assure product quality during and after production. In the past, measurement for process control was mostly a static or "snap shot" kind of activity. A measurement was made at a particular stage in a process and an adjustment made if necessary, another measurement and adjustment might be made at a later stage, and so on. By contrast, many modern processes require a dynamic measurement capability. Continuous processes require continuous measurement, and the ability to respond continuously to measurement changes.

Similarly, quality assurance was once considered to be mostly a matter of final inspection at the end of the production line. Today, automation and dynamic measurement make it possible for quality assurance to be an integral part of the production process. Today, machines are being programmed to measure their own attributes, to measure the attributes of the products being processed, and to adjust the process automatically to account for deviations from some ideal. These capabilities are profoundly changing the nature of process control and quality assurance. New measurement technologies have the potential for making processes vastly more efficient by reducing waste, improving product quality, and reducing down time.

I believe the National Bureau of Standards has a major role to play in the support of these new measurement technologies. Its products and services will be instrumental to American industries ability to advance into new and emerging area of industrial need. Through cooperation with firms, industry, associations, other Federal agencies, State and local governments, and standards bodies, this relatively small laboratory exerts tremendous leverage on the U.S. economy.

Question. You now have an Automated Manufacturing Research Facility (AMRF). I understand that its purpose is to make different kinds of robots work together on the factory floor. You also are working with a wide range of American companies, including General Motors.

Can you tell us some more about this facility? What research are you doing? Has industry supported the project? What benefits to American Manufacturing may come out of the Research?

Answer. The AMRF serves as a testbed for a variety of technologies and measurements involved in Computer Integrated Automated Manufacturing (CIAM). Technology transfer occurs through the vehicle of Industrial Research Associates, University researchers, and others working at the facility as well as a testbed for NBS research in the metrology associated with automated manufacturing.

The AMRF plays a key role in laying the groundwork for incremental implementation of CIAM by supporting the establishment of standard interfaces between pieces of equipment, and between integrated equipment and a central control system, and by providing the means and methods of in-process measurement.

In the area of robotics, NBS is carrying out extensive research in the control and utilization of robots both stationary and mobile. We are using the AMRF to test a

number of commercial robots, including the June 1984 successful test of the Cincinnati Milicron T3 commercial robot.

NBS is conducting fundamental research into sensory interactive control of robots including research on vision, tactile sensing, and proximity sensing for real-time control.

Considerable progress has been made in programming, testing, and debugging robots using our Real-time Control System (RCS).

We have Industrial Research Associates (IRA's) from Honeywell, Westinghouse, General Dynamics, Boeing and IBM working on robotics using the AMRF. In addition, industry has provided in excess of $3.5M in the form of equipment for the AMRF.

The payoff of the AMRF is both ongoing and long term. The ongoing payoff occurs through transfer of technology from the AMRF to U.S. industry, thus supporting accelerated commercialization of the components of Computer Integrated Automated Manufacturing. The long term payoff will be U.S. manufacturers applying a machine-and-process-independent central control structure for automated manufacturing systems, standards for communication between distributed databases, and the ability to measure output during processing.

Question. One of our most troubled American industries is steel. Recently you announced a new effort with the American Iron and Steel Institute to develop an ultrasound sensor that can detect flaws in hot metal and more accurately crop unsound material before it is run through the complete production cycle.

When will this new research begin? How much will industry contribute to it? What benefits might result from it?

Answer. The American Iron and Steel Institute began a collaborative research effort with NBS about two years ago. The thrust of this effort is to develop sensors for on-line, real-time control of steel processing. AISI is currently supporting four part time Research Associates from various steel companies which work side-by-side with NBS staff.

Results of a small NBS effort to improve detection of flaws in hot metal have been reported and are being evaluated for use in pilot plant tests supported by industry. AISI spent $225,000 in 1984 and will spend $185,000 in 1985 for evaluation and further development of this class of sensors.

The majority of NBS' efforts are related to sensors for the detection of the solid-liquid interface in continuous casting and for the determination of the temperature profile within large steel bars and plates. Development of these sensors and two other sensors were determined to be of highest priority at a National workshop on Process Control Sensors for the Steel Industry. The workshop was organized by the General Research Committee of the AISI.

NBS, along with the industry supported Research Associates, will provide the fundamental research and prototype development. If solutions of the difficult research questions are found, AISI will work with the manufacturers of sensors in pilot plant testing and commercial development. This phase of technology transfer will be the responsibility of AISI and individual steel companies and will be accelerated by the steel company Research Associates who collaborated in the research efforts. The research efforts currently underway are contributing to the science base and will likely have significant benefits throughout the entire metals processing industry--not just steel.

Question. As you mention in your testimony, in 1983 this country spent $163 billion on measurement activities—including instruments and measurements related to research, product design, manufacturing processes, and quality control. This is a staggering number.

How are measurements important in the development of new products and manufacturing processes? Given the new emphasis on high-technology products and improved manufacturing, do you expect the national investment in measurements and instruments to increase?

Answer. We have reason to believe that U.S. industry is already more measurment-intensive than my testimony indicated and is becoming more so. First, the Department of Commerce Input/Output data on which the equipment portion of the estimate was based were from a 1972 survey of business (the latest data available to us at the time), extrapolated to 1983 in a study for NBS by P. DonVito entitled "Estimates of the Cost of Measurement in the U.S. Economy," prepared for the National Bureau of Standards (Planning Report 21), November 1984. Commerce data show that over the past decade the instrument industries have had the second highest growth rate in terms of output among manufacturing sectors. Our studies show that the measurement component of value added by this sector is approximately three times the national average. Secondly, the firms we surveyed continually told us that

their production processes were becoming more measurement-intensive. Thirdly, as indicated in my response to question A1, new technologies are profoundly changing production technologies into much more measurment-intensive automated processes.

Measurements increase the productivity of industrial R&D by permitting the scientific and engineering principles to be demonstrated for the first time or to be demonstrated at higher degrees of accuracy and precision. Measurements are becoming increasingly important in the monitoring and control of production processes. Real-time process control, which greatly increases productivity, requires significantly more types of measurements and more technologically complex measurements than conventional end-of-the-line inspections. Finally, as new products become more complex technologically, buyers experience greater difficulty assessing manufacturers' performance claims. Measurements must be developed and agreed-to by buyers and sellers so that acceptance testing can be efficiently accomplished and new products thereby rapidly accepted (i.e., diffused) into the marketplace.

Question. The taxpayers spend over $120 million a year on the National Bureau of Standards.

Why do we need a government laboratory to help industry with its measurement work and product standards? In your experience, is industry willing and able to develop these measurement methods and standards on its own? Will industry develop impartial and non-proprietary technical information?

Answer. Industry creates many of the test methods and measurement devices needed for their own products processes. As the question suggests, however, much of this technical information is proprietary. In addition, many measurement-related technologies will not be produced by an individual firm or industry group. Because of their nature, these specialized technologies do not offer firms an adequate return on the money (investment) required to produce them. Sometimes, an individual firm or industry group cannot afford to create at all, and other times a technology or industry is so competitive that firms are unwilling to cooperate—even if all firms could benefit—for fear of revealing company secrets.

To get an adequate return on money invested in any technology, a firm has to make it proprietary—keeping it secret or patenting it. But infrastructure technologies such as test methods and industrial standards are only valuable when they are used by all firms in an industry. There is no incentive for a firm to patent and charge for a test method, because the value of the test method, its intrinsic nature, lies in its uniform use throughout an industry.

Measurement technologies frequently require expensive equipment and highly skilled staff which have limited usefulness to a particular firm or industry. Thus, the measurement-related research of a particular firm or industry may have insufficient scale to be efficient. Individual firms and industries tend to use a limited set of measurment methodoligies, but the science and technology of measurement is highly interrelated and can be applied to the problems of many different industries. Thus, the measurement-related research of a particular firm or industry may have insufficient scope to be efficient.

Yet, the overall economy benefits greatly from these measurement technologies. The first rationale for a national measurements and standards laboratory is based on this economic imperfection: Everyone benefits, but no one benefits enough to see that the work gets done. In these cases, when industry lacks the capability or incentive to create essential measurement science and technology, NBS has the mission and the competence to see that the work gets done. In all cases NBS works closely with industry to determine industrial needs. In many cases, cooperative projects are conducted with the exchange of personnel or equipment or the sharing of work.

The second rationale for a national measurements and standards laboratory is based on the need for equity and uniformity in the market place and, thus, for a competitively-neutral, technically-competent third party in the market to facilitate consensus formation among competitors. Measurement methods, standards and data are critical for conducting and transmitting the results of R&D, for controlling production processes, and for assuring buyers and sellers that products perform as specified. The integrity and the efficiency of the market place depends on the development of technically sound, mutually agreeable measurement tools. Frequently, the presence of a competent, neutral government laboratory can provide the basis for agreement among competitors, without undermining their proprietary technologies.

Question. NBS charges industry for many of the services it provides.

Can you give some examples of the specific services and products that you make available to industry? How much money does the government receive for these services and products?

Answer. Examples of measurement and calibration services include: dimensional measurements such as volume and density, fluid flow measurements, a variety of

electrical measurements, frequency measurements, and optical and ionizing radiation measurements, among others. A wide range of products are also available to industry in the area of Standard Reference Materials (SRM's). Some 1000 of these SRM's cover certified standards for chemical composition, physical properties of materials, and engineering applications. In FY 1985, NBS will receive approximately $9.2 million from public and non-federal government reimbursement of calibration and tests and other technical and advisory services. An additional $4.8 million is anticipated from sales of Standard Reference Materials.

Question. Of all the national laboratories, you have the closest relationship with industry. You also work closely with scientists from other federal agencies. Your testimonys says that over 150 industrial researchers now work at NBS on topics of mutual interest—with their sponsors, not NBS, paying their salaries.

Do you find that this close collaboration is a good way to spread NBS' technical discoveries to industry and other Federal agencies? What does NBS get in return from this collaboration?

Answer. Close collaboration with researchers from industry and government provides a means for disseminating NBS-developed measurement techniques through these researchers who learn first-hand their proper application and demonstrated validity. This collaboration also affords NBS direct channels to collect information on the needs of industry for new measurements and services. The researchers also bring to NBS current industrial practices and techniques that aid in developing test procedures and other NBS products that will be of direct benefit to industry and other agencies.

RESEARCH ON FIRES, BUILDINGS, AND COMPUTERS

Question. Once again, the Administration proposes to abolish the Center for Fire Research (CFR), abolish the Center for Building Technology (CBT), and cut the Institute for Computer Sciences and Technology (ICST) in half.

One of OMB's arguments for eliminating CFR and CBT is that fire and building research is the responsibility of the states and the private sector.

I know that you are a loyal member of the Administration, but is it not true that both CFR and CBT serve important roles along with their advice to the states and private industry?

In particular, the Fire Center provides technical advice to the Consumer Product Safety Commission and other Federal agencies, does it not? Is the Building Center not part of the National Earthquake Hazard Reduction Program, providing essential technical advice on earthquake-resistant buildings to other federal agencies?

Answer. The work performed by and role filled by both CFR and CBT are important, but it is the position of the Administration that the work being done and the role filled by those two organizations are best handled by state and local governments.

CFR does do contract work for other agencies, but it is the position of the Administration that the work of CFR can best be handled by the organizations involved, be they Federal, state, local governments or the private sector.

CBT is a part of the NEHRP and its role in the program was described in the report recently submitted to Congress.

Question. The Administration's case for abolishing the Fire and Building Centers rests on the premise that the private sector will perform this important research to reduce fire deaths and building hazards.

To the best of your knowledge, has the Administration received any firm commitments from the private sector to assume these responsibilities if the Centers (CBT and CFR) are abolished? Does the Administration have any evidence or analysis that suggests why private firms would assume these responsibilities or deliver research findings in an impartial, non-proprietary way?

Answer. No. There is obviously no incentive for any private sector firm, university, state or local government or association thereof to indicate a firm commitment to assume any or all of the responsibilities of CBT or CFR as long as U.S. taxpayers subsidize this work. The Federal Government should still, however, withdraw from areas in which state and local government have unchallenged responsibility, particularly when Federal Government is facing dramatic deficits and state and local governments are experiencing budget surpluses. The construction and insurance industries in cooperation with state and local building authorities can and should support this research, perhaps even through the National Conference of States on Building Codes and Standards which can require the dissemination of research findings for the public interest and safety.

Question. The Administration proposes that voluntary standards organizations be relied upon for the majority of Federal computer standards.

Since standards organizations often proceed slowly unless they have good leadership, do you expect that we will see fewer governmentwide standards and more agencies developing their own individual and incompatible computer standards?

Answer. There are various reasons why standards organizations proceed slowly—both with and without Federal Government involvement in the form of technical support. Given this, it is possible that fewer governmentwide standards may be developed than would otherwise occur. There also exists a likelihood that more agencies may develop their own standards and that a degree of incompatibility may be a consequence.

Question. The Administration proposed to cut your fiscal year 1986 equipment budget by $3.3 million.

What percentage of your total equipment budget does this $3.3 million represent? Given that you are a technical agency, and scientific instrumentation quickly becomes outdated, what effect will this cut have on our performance? Can we expect this cut to be restored in the Administration's fiscal year 1987 budget?

Answer. The $3.3 million represents approximately 25 percent of our annual equipment budget.

In 1976, a determination was made by the Administration and Congress to transfer funds to the Bureau's WCF for equipment replacement to compensate for the annual effects of inflation. This decision was precipitated by 1972 and later studies of its equipment replacement needs. The goal of the program, as set out in the studies, was to raise the availability of funds to the Bureau for the purchase of equipment and inventories to offset the effects of inflation and to reach a level commensurate with that of comparable Federal laboratories. The Bureau reached that goal in fiscal year 1985 with the transfer of $3.265 million for equipment replacement. Therefore, no additional appropriations are necessary in fiscal year 1986.

Congressional acceptance of the NBS proposed authorization and/or the appropriation language for fiscal year 1986 will allow NBS to recover equipment costs at current value. This method will return NBS to the present level of equipment purchases. In fiscal year 1987, NBS will request an adjustment to base to finance approximately 60 percent of the equipment replacement augmentation costs. The appropriation level is reduced by enabling NBS sponsors to help finance equipment replacement.

THE FOUR INITIATIVES

Question. You are requesting $1.9 million for process and quality control measurements.

Would you explain how NBS measurement work can help industry improve their process control and quality control, what the three projects included in this year's request do, and which industries would they help?

Answer. Two key ingredients are vital for industrial process and quality control: standards and measurement technology. Standards provide the basis against which actual product attributes are compared to determine product quality. Measurement methods/techniques and data provide the means the comparing products against standards. A sound measurement system is vital to the research upon which new products are developed, to the assurance of quality and efficiency in manufacturing operations, and to the maintenance of equity in trade. Working with industry, NBS plays the control role in developing the basis to which all these measurements are referred.

Advances in technology place increased demands on NBS measurement services. The $1.9 million would fund the development of advanced measurement methods and basic standards in the areas of spectroradiometry, impedance, and microwave measurements, all of which have been listed as top priorities by a panel of industrial experts. The spectroradiometry project will allow NBS to implement a new approach to radiometric calibrations based on solid state detectors in addition to traditional lamp standards. This new approach is essential for reliable measurements in this lighting, photographic, and electro-optics industries. The electrical impedance project will provide new automated capacitance and inductance calibration systems with extended ranges and a new calibration service for dissipation factor measurements, which will impact precision electronic instrument manufacturers and electrical component manufacturers. The microwave measurement project will provide new methods and standards for microwave measurements such as microwave power, attenuation, reflection coefficient, and noise in the frequency range used in advanced communications and aerospace systems.

Question. Your testimony mentions that the proposed "cold neutron source" will be able to make key measurements of the internal structure of a wide range of materials, including ceramics and composites.

What are "cold neutrons?" What can a cold neutron source tell us that x-rays and electron microscopes cannot? How will measurements from this new machine help American industry develop advanced materials?

Answer. Cold neutrons are neutrons whose velocity has been reduced by interaction with a very cold moderator (frozen heavy water at 40 K). These cold neutrons have a longer wavelength than the faster thermal neutrons typically utilized at research reactors.

Cold neutrons have unique properties compared to x-rays and electrons. For example, the neutron has a magnetic moment which enables characterization of magnetic materials that is not possible with x-ray scattering and electron microscopes. The depth of penetration of electrons, x-rays and neutrons each differ by approximately 10 to 100 times with neutrons having the greatest penetrating power. Neutrons therefore provide the best probe for characterization of bulk properties. The long wavelengths of cold neutrons are particularly useful in studies of molecular sized assemblages (e.g. polymer folding, ceramic agglomerates and voids, alloy precipitates) while the shorter wavelength x-rays are primarily utilized for research at atomic scales.

The recent National Academy study (Seitz-Eastman) of major materials facilities gave cold neutron facilities highest priority. The evaluation criteria included importance to industrial innovation and competitiveness. The Cold Neutron Research Facility will open to the U.S. industry a variety of research capabilities currently available to French, German and British industries. There is a wide range of applications, particularly in advanced materials, including high strength polymer blends, high technology magnetic materials, semiconductor technology, and composite materials. Industry will perform basic and applied research at state-of-the-art experimental research stations. Up to one-third of the fifteen planned research stations will be reserved for participating research teams to develop specialized experimental capabilities.

Question. You also propose a new $3.5 million initiative in advanced ceramics, a field of potentially great economic importance. Your work seems aimed at developing new measurement techniques to detect and prevent flaws in these new materials.

What are some of the potential applications for these materials? What are some of the problems that now exist in manufacturing reliable ceramics? What specific activities will you undertake to address these problems?

Answer. Manufacturers of advanced ceramics are severely limited by a lack of understanding as to why components cannot be reproducibly produced with reliable properties. Frequently, knowledge is lacking of what characteristics to monitor. In cases where knowledge exists, methods to translate research measurement capabilities to the production line are missing. The advanced ceramics initiative will provide measurement methods, key data, reference materials, and predictive concepts that U.S. industry needs for the development of processing methods for reliable advanced ceramics with reproducible and controlled properties.

If the technical barriers are eliminated then advanced ceramics will find a very broad range of applications related to their fundamental properties: light weight; great hardness and strength; and specialized optical, electrical and magnetic properties. For example, because of their strength, wear resistance and stability at very high temperatures structural ceramics are being pursued worldwide as heat engine components. The projected multibillion dollar economic benefits associated with a successful heat engine development accrue from the greater fuel efficiency obtained by operating at temperatures much higher than possible with metals. Important applications also exist in electronic materials, cutting tools, bioimplants, optoelectronics, and cutting tools.

Question. A key part of the ceramics initiative is to measure ceramic structures on a microscopic level in order to detect potential flaws that could make these materials brittle or unreliable.

To what extent will this initiative depend on the cold neutron source to measure and characterize these ceramic structures?

Answer. Advanced ceramic research requires a wide array of instruments and facilities. For example, scanning electron microscopes, automated x-ray diffractometers, mechanical testing stations, controlled atmosphere furnaces, particle size counters, and spectrometers will be utilized daily. The existing NBS Research Reactor is another key facility for the proposed research in advanced ceramics. The Cold Neutron Research Facility will significantly expand the array of characterization

tools and provide unique capabilities that will certainly benefit the Advanced Ceramics program. Yet no one resource is critical. Providing NBS services to industry, government and academia will require utilization of all our equipment resources.

Question. You request $3.0 million for work on industrial applications of biotechnology. Most of us think of genetic engineering and new medical advances when we hear the word "biotechnology," but I gather your initiative has more to do with the use of biotechnology to improve productivity and products in industry—particularly the chemical industry.

What economic opportunities exist in industrial biotechnology? What "technical barriers" now exist in this new field? What will NBS's initiative do to help overcome these barriers and help American companies?

Answer. Biotechnology will have major impacts on many sections of our economy. From 1980–82, ninety-one new biotechnology companies were established in the U.S. alone, and the number of U.S. companies is expected to increase dramatically by the end of the century. The global market for biotechnology-based products is estimated to be $100–200 billion by the year 2000. The commercialization of biotechnology will be heavily dependent upon measurement technology at all phases of R&D, processing quality assurance, occupational health and safety, environmental monitoring, regulatory applications and trade. Lack of measurement methods and large measurement variability are technical barriers inhibiting the commercialization of biotechnology. NBS can utilize its physical, chemical, and engineering expertise to focus on a few key measurement problems which are common to all applications of biotechnology ranging over a diversity of industrial sectors.

Question. Normally in science, proposed new programs go through a process of peer review, to ensure that they are technically sound and address key scientific concerns.

What kind of peer review did the ceramics and biotechnology proposals go through? Are you confident that these proposals have the support of the scientific community?

Answer. NBS is involved directly and continually with industry, universities and other government agencies—from the time a program is first planned through the actual provision of measurement services resulting from Bureau research. The NBS Visiting Committee and the NAS/NRC Boards of Assessment of the NBS research groups where the biotechnology and ceramics work will be conducted include representatives from industry and universities. Through them, peer group review is conducted on a continuing basis, not only of the plans for providing measurement services and standards for biotechnology and ceramics, but also the quality of the scientific work itself. As it has with other programs, NBS management will communicate directly with industrial management and with representatives from trade associations and universities in planning and conducting the biotechnology and ceramics programs.

Question. I have two questions about the direction that the ceramics and biotechnology initiatives will take.

First, which concerns will you emphasize? Will immediate industrial needs or scientific merit be given top priority in these programs?

Second, how will you cooperate with other research programs, both private and corporate? For example, what other research labs are looking at ceramics and industrial biotechnology, and how will you interact with them?

Answer. The NBS program in biotechnology will concentrate on a system to measure and predict quantitatively protein structure and function; separate, detect, and measure accurately biomolecules, their substrates, and products in complex mixtures; and predict, monitor, and control the operating environment of bioreactors including devices for the separation and purification of products. Cooperation with other research programs will be carried out through solicitation of visiting scientists and industrial research associates placed at NBS by these programs. In addition, contact is being made with applications—oriented biotechnology research centers throughout the U.S. which need reliable measurement technology for effective development of their products and services.

The advanced ceramics program will focus on all aspects of the improvement of the processing cycle. The principle feature will be the understanding of flaws: e.g. at what step in processing do they originate, how can they be minimized or avoided, and what data and reference materials are needed by industry. Data evaluation efforts can be readily directed into areas of greatest industrial need. Data programs, such as the ceramic phase diagram and the x-ray powder diffraction reference data efforts, performed in collaboration with professional societies will be closely geared to industrial needs. In other areas such as fine-particle, ultra-high-purity synthesis there is a balanced need for research and creativeness. Coupled with this research

will be needs for improved measurement methodologies to accurately characterize the powders and to correlate their features with properties of ceramic products.

The advanced ceramics program has been developed in consultation with university-industry consortia (MIT and Rutgers), industry leaders, and with encouragement of DOE laboratories. In all cases, it is clearly recognized that NBS has a unique responsibility to fill within the national effort to support the national economic policy goals in advanced materials. Cooperative programs will grow between NBS and the university-industry consortia, professional societies, and with other government laboratories.

Senator GORTON. Our first panel, each representing one of the areas proposed either for elimination or reduction, consists of: Mr. John Gerard of the National Fire Protection Association; Mr. Vico Henriques, president of the Computer and Business Equipment Manufacturers Association; and Mr. John Bush of the National Institute of Building Sciences.

If they would come up there, and we will start with Mr. Gerard.

Your formal written statements will be included in the record and we appreciate your limiting your opening statements to not more than 5 minutes.

STATEMENTS OF JOHN C. GERARD, WASHINGTON REPRESENTATIVE, NATIONAL FIRE PROTECTION ASSOCIATION; VICO HENRIQUES, PRESIDENT, COMPUTER AND BUSINESS EQUIPMENT MANUFACTURERS ASSOCIATION; AND JOHN BUSH, BOARD MEMBER, NATIONAL INSTITUTE OF BUILDING SCIENCES

Mr. GERARD. Yes, sir, Senator. Thank you.

A very short synopsis of the National Fire Protection Association. We were founded in 1896. We are a nonprofit organization. We basically focus on technical and educational activities. We have been since our founding the principal public advocate for fire safety in the United States.

And our 32,000 members represent all facets of fire protection. We are not a trade or an industry association. We are basically focused on improving fire and life safety in the United States.

But we are not here to talk about the NFPA. We are here to talk about the Center for Fire Research, or at least I am. And as you accurately pointed out, for the third year in a row the Center for Fire Research is threatened with extinction.

It is our view that the existence and the continued functioning of the Center for Fire Research within the NBS is absolutely essential. Since 1904, the National Bureau of Standards has done fire research, when they began to do some work on standardization of fire hose couplings, which incidentally is still going on in some of the smaller communities in the United States. This work was begun at NBS a long, long time ago.

Dr. Ambler pointed out that NBS priorities are adjusted each year to reflect the changing priorities and attitudes of the American people, and I can tell you, Senator, that the attitudes of the American people are stronger now than they have ever been in their concern for fire safety. Just in the past several years, with some of the major hotel fires and some of the other major industrial fires that have occurred throughout the world, the American people's concern for fire safety is greater than it has ever been. So if anything, the National Bureau of Standards should be adjusting

their priorities in a direction opposite from eliminating the Center for Fire Research.

The Center is not simply an abstract scientific experimental laboratory. The Center for Fire Research activities go beyond initial research and they produce practical tools that have great benefits for the American people.

The Center for Fire Research did the original studies on smoke detectors in 1972. As a result of the work that the Center for Fire Research began in 1972, last year for the first time, for the first time since we have been keeping statistics, the loss of life due to fire was under 6,000 people a year, a very direct reflection of the work done by the Center for Fire Research in developing smoke detectors so that we can all have a smoke detector in our home. Until they began their research, residential smoke detectors were virtually nonexistent.

When you go home this evening, I suggest that you take a look at the carpet that you are standing on. In 1970 the National Bureau of Standards began research and completed studies that developed carpet standards that would keep carpets from igniting from small ignition sources and cigarettes.

No mattresses sold since 1973 can be ignited by a cigarette, as a result of research done at the Center for Fire Research.

Today the Center is doing research in the area of toxicity, in the area of fire-safe cigarettes. In fact, they are the lead organization developing a fire-safe cigarette. Given the highly charged nature of this type of research, it is absolutely essential that that work be done in Government. It is not possible for this work to be done in the private sector.

Now, in addition, I find it interesting, this is the second hearing I have been to where the illusion is to transfer this activity—they say it very fast so it sounds like one word, "to the private sector, State and local government." Saying it fast does not make it real.

Before I came to Washington in 1982, I was with the Los Angeles Fire Department. I retired as the fire chief there. The Los Angeles Fire Department, as the Seattle Fire Department, is very innovative, at the very forefront of activities. We did research in Los Angeles. The Seattle Fire Department just completed some research on smoke movement in buildings.

That sort of thing is not funded by local government. It is funded by the Federal Government. That research is done under grants from the Federal Government. Local government does not have the money to do that, even if they had the capability. In addition the type of research that is done by the Center for Fire Research cannot be done by any local government, because they simply do not have the laboratories.

It cannot be done by the private sector because it is basic research that ultimately leads to product developments.

Dr. Ambler referred to the meeting that was held on research in Massachusetts. The National Fire Protection Association was a cosponsor of that study and I would like to read for you, and then I am going to shut up, just one of the recommendations.

It is the second recommendation that came out of that study. Dr. Ambler was absolutely correct, they did not recommend assuming

that research in the private sector. What they recommended was that:

The Center for Fire Research, fulfilling the crucial role of spearheading and coordinating basic and generic applied fire research through independent research within the Center, by provision of grants, fellowships, and technical support to independent researchers and universities and similar institutions, and by serving as an objective forum for reviewing and coordinating the national research effort.

In other words, that study said: keep the Center for Fire Research; it is not possible to transfer that activity to the private sector or to State and local government.

I thank you very much for the opportunity to be here today, and I would be happy to answer any questions that you may have.

[The statement follows:]

STATEMENT OF JOHN C. GERARD, NATIONAL FIRE PROTECTION ASSOCIATION

The National Fire Protection Association (NFPA) expresses its opposition to the Administration's FY'86 budget proposal that would provide zero funding for the Center for Fire Research (CFR) within the National Bureau of Standards (NBS) and, thus, eliminate this important scientific research unit within the Federal Government.

The NFPA, founded in 1896, is a non-profit, technical and educational membership organization. It has remained the principal public advocate for fire safety since its inception. The Association's membership of over 32,000 is drawn from the many disciplines involved in, and concerned about, the national fire problem. NFPA is not a trade or industry association. No one group or interest is dominant. The only common membership denominator is a concern for fire safety. Members include fire service personnel, fire marshals, electrical inspectors and city managers; architects, engineers and educators; health care facility operators and similar groups from commerce, industry, insurance and the Federal Government. The NFPA is best known for its voluntary safety standards, collectively known as the National Fire Codes which, in whole or in part, are incorporated by reference into numerous federal, state and local laws and ordinances.

Thanks to action by the Congress last year and the year before the CFR was saved. This year the elimination of the Center for Fire Research is once again proposed.

In NFPA's view, the existence and continued functioning of the NBS Center for Fire Research is essential. Historically, the NBS has had a fire research capability since 1904, at which time standardization of fire hose couplings was an issue. In subsequent years, the Fire Resistance Section was established within NBS. With the enactment of the Fire Research and Safety Act of 1968 the organization was formalized. Subsequently, Section 18 of the Fire Prevention and Control Act of 1974 amended the NBS Organic Act thereby creating the Center for Fire Research in its present form.

It would be a mistake to view the workings of the NBS Center for Fire Research as simply abstract, scientific experimentation. Although the Center is a community of scientists and engineers and much of the work is, in its initial form, relatively abstract, one of the distinguishing features of this particular part of NBS is that the Center goes beyond this initial research to produce practical tools that have great benefits.

For example, the Center began fundamental studies of residential smoke detection in 1972. At that time, home smoke alarms were virtually unknown in this country. Two years later, a test method for residential detectors was published by NBS and adopted by Underwriters Laboratories as the basis for that organization's certification and labeling program. These developments set the stage for the explosion of smoke detector sales in this country. Today two out of every three homes in the United States has this life-saving device and life loss due to fire is on the decline. That would not be the case if it weren't for the pioneering work of the Center for Fire Research.

One reason we feel safe in most buildings is that we are fairly confident that a fire will not cause them to collapse before we can get out. Buildings don't just happen to be built that way—the concepts of fire endurance, which are the bedrock of modern fire protection, were developed at NBS fifty years ago.

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When you go home this evening, take a moment to look at your carpet; work completed at NBS in 1970 has ensured that carpet manufactured since that time will not ignite from a dropped match or similar small ignition source.

No mattresses sold since 1973 will ignite from a cigarette—again thanks to work done at NBS.

There is scarcely an area of practical fire protection which does not show the imprint of work done by the Center. Fire fighters wear improved protective clothing; buses, subways, trains and airplanes are more fire safe; hospital and nursing home fires are increasingly uncommon—all due to research done and put to practical end use as a result of the work of the Center for Fire Research.

NFPA doesn't think anyone can seriously suggest that the Center doesn't earn its keep—a single famous hospital in Massachusetts saved more money by applying CFR-developed fire protection technology than it costs to operate the Center for eighteen months. Rather, the issue is whether the private sector can do as well or better in providing this technology. In our view, it cannot—in fact, it can't even come close.

It takes money to do this work, and in the private sector, one cannot spend money unless there is a clear financial return. Safety standards, such as those of NFPA, invariably involve product exclusions. This means that the research that often underlies the standard must be technically sound and free from bias. Even when privately funded research meets these tests, the conflict level that accompanies standards development will be raised. That level is already high, and the risk is run of having fire safety being finally determined in the courtroom, not the laboratory. By the same token, the costs of standards development would increase dramatically.

The crucial and irreplaceable element that NBS brings to the fire safety community is credibility. Private funds doing the same research could not have the same impact.

Furthermore, the Center is an interdisciplinary organization. No single industry would be willing to support such a diverse collection of specialities. Yet, without that diversity, the breakthroughs are not going to be realized.

For example, mention was made that the Center had developed cost-saving technology for hospitals. That involved the concept of the Fire Safety Evaluation System (FSES) for Hospitals and Nursing Homes, a concept that is now also part of the National Fire Codes. Using this system, building owners and developers can meet code requirements with far more flexibility and, therefore, at much lower cost than was previously the case. The savings potential for health care facilities alone in the United States is in the billions of dollars—and comes at a time when other health care costs are skyrocketing. On one hand, the Center had assembled the physicists, psychologists and engineers to compare and evaluate fire protection methods and, on the other, the Center had the credibility in the building and regulatory community to gain review and acceptance of the concept from those who would use it day-to-day.

In summary, considering the highly-charged nature of the work done by the Center for Fire Research, it is absolutely essential that this work continue within government, and not in the private sector, as this possibility is being proposed by the Administration. It cannot be transplanted without creating a vacuum in essential independent research and opening a door to judicial challenges.

Further, the locus of the Center for Fire Research within the NBS, and not in some other government agency, is fully justified because of the universal recognition of NBS' scientific stature and because of the beneficial synergistic effects that comparison and correlation with other scientific disciplines in NBS provides. Not one university or private research institution in the United States is able to provide this inter-disciplinary approach.

As we are sure the Subcommittee will realize, the Center's work products not only benefit the NFPA, but also underlie much of the private sector's product certification activities.

To emphasize our point once agein, even if the NBS Center for Fire Research could be physicially duplicated within the private sector, the credibility of such an entity would be far less than that of the existing NBS organization. Much more can be said on this subject, and we have tried, in an attachment ot this statement, to deal briefly with a few of the most important aspects of the question: "What if the CFR is shut down?"

In conclusion, the NFPA urges the Science, Technology, and Space Subcommittee to recommend continuation of the Center for Fire Research at the FY'85 funding level.

ATTACHMENT.—WHAT IF THE CFR IS SHUT DOWN?

1. The fire safe cigarette research must be completed.—This essential research can only be accomplished by CFR. It took 50 years to get a bill written that Congress could support. The bill requires CFR to perform the research necessary to make "fire safe" the number one cause of fire deaths in the United States.

2. Combustion toxicity is an issue where the CFR is required.—The tremendous public debate over combustion product toxicity is one in which there is almost no neutral ground. Those responsible for public safety get facts from combustible materials industries on one side, and those who make non-combustible products on the other. While there may be valid points on both sides, regulators are poorly equipped to determine which information is fact and which is simply self-serving in this complex area. The Center is the only credible source of technical information and, hence, occupies the only neutral ground in a hotly contested arena.

Neither NFPA nor the two largest independent fire testing laboratories have any biological testing capability. Several smaller testing laboratories do, but they are already trying to sell their particular tests, so it's hard to see who would fill the need for neutrality. Yet, if the CFR is not funded, near anarchy could result.

3. Private sector not equipped to pick up work of the CFR.—As part of NBS, the Center for Fire Research's job is to develop methods to measure fire performance and to help decide what level of performance is needed. By contrast, industry provides proprietary products and services. In fire protection, these proprietary products usually must meet specific requirements—requirements that are often set based on work done by the Center. At present, NBS and the private sector do not compete, but perform complementary functions.

If the Center were to be abolished, the private sector would have to take on the role of umpire where now it is a participant in the game, and this raises a potential for severe conflict of interest.

4. Other countries have national fire research laboratories.—Most Western European countries, as well as Canada and Japan have government supported fire research laboratories. (Even China and the Soviet Union have such organizations.) Although input from the private sector is encouraged, in no case is the responsibility for code-related research left in the hands of industry.

5. Center supports most fire research in this country.—If funding is halted for the Center, virtually all fundamental research in fire would cease. This is because the Center supports all of the university-based research in the area, as well as its own in-house program. Therefore, shutting down the CFR shuts down more than an organization—it shuts down an entire area of science.

6. Rebuilding capability at the CFR is not readily done.—In addition to its operating budget, the Center has perhaps $10 million in equipment and facilities, most of it immovable.

If the private sector were to assume the role now played by NBS, NBS would either have to make these facilities available to tenant researchers or the facilities would have to be duplicated elsewhere.

Where testing is routine, private laboratories already carry out testing on a business basis. For example, Underwriters Laboratories uses a number of CFR-developed tests as part of its listing services.

The development of test methods and criteria involves a breadth of staff and facilities that even the largest private labortories do not possess. It is obviously more cost-effective for NBS, using existing laboratory facilities, to continue developing test methods than for several laboratories, independently, each to build such facilities and develop their own, proprietary, competitive test methods.

[The following information was subsequently received for the record:]

QUESTIONS OF SENATOR GORTON AND THE ANSWERS

Question. Mr. Gerard, as you know the Center for Fire Research provides $2 million annually for fire research in universities and research institutions.

If this flow of funds stops, how much basic fire research in universities will continue?

How important is such rescarch to the fire prevention community?

Answer. I cannot speak with an absolute certainty but I do know this—research costs money, even in a university, therefore, it follows that if the funds from NBS stop it will create a void which will not be filled from any other source.

The development of new and improved technology to deal with the fire problem in the United States is critical. Basic research is essential to develop the means for stepping out of the past and into the future.

Question. Mr. Gerard, does the Center for Fire Research have unique equipment or facilities which would be difficult for the private sector to replicate?

Would it be possible for the Bureau to rent out its unique facilities to tenant researchers?

Answer. Yes, the Center for Fire Research has an unique capability to conduct research that cannot be replicated in the private sector. Even more important than the hardware and facilities, however, would be the loses of the multi-disciplinary staff that has taken the past ten years to assemble and develop into a team.

I suppose it is possible. The question is: Would it serve the same purpose, i.e., unbiased, objective research and the answer, without prejudice, is no.

Question. Mr. Gerard, the Center for Fire Research has been level funded for several years. Has the lack of funding increases affected the quality or level of research performed by the Center? Do you feel there are research areas the Center should be exploring but isn't because of lack of resources?

Answer. Level funding at the CRS has had no affect on the quality of work done, however, it has limited the number of research projects and reduced the scope of those. This subject area requires a broad-based objective team of unbiased researchers, willing and able to report their findings with courage and candor. Such a group is the research team at CFR.

Senator GORTON. Thank you very much, Mr. Gerard, for a most helpful statement.

Mr. Henriques, we will hear from you.

Mr. HENRIQUES. Thank you, Mr. Chairman, members of the subcommittee:

We appreciate the opportunity to speak to you today. CBEMA is the trade association of manufacturers and assemblers of information processing, business and communications products, supplies and services. I was glad to hear Dr. Ambler talk of the biotech market influence and the economic position that he hopes that biotech will take in the next few years, because there is a very close analogy in the field of computers.

Our 40 member companies had combined revenues of almost $112 billion in 1983. They employ more than 1.2 million people worldwide and have contributed to a positive balance of trade last year in 1984 of $4.75 billion. That is in products only. We do not know quite yet how to measure the intangibles, as it were, in licensing and commerce in technology, but these would add significantly, perhaps as much as 50 percent more to the positive balance of trade.

My career in computing and communications began at the National Bureau of Standards in 1956, and since then I have been involved in the development and use of this technology both in Government and in industry. I have been involved throughout that period of time in the development of national and international computer technology standards, and have a firsthand knowledge of the technical and political challenges faced by the Institute for Computer Science and Technology.

We are deeply concerned about the proposed 50-percent reduction in the ICST funding. This is the fourth year that such proposals have been made, and we think that this would affect a critical national resource, the ICST, that focuses Government agency requirements and represents these requirements in arenas where national and international standards are developed.

ICST is uniquely situated to be an effective and impartial negotiator in the standards development process. It promotes voluntary

international standards that help to preserve our industry's competitive position in the world market, while supporting the users' needs for standards to achieve increased productivity and delivery of services at reduced costs.

As you know, it was the Brooks Act that established the ICST with three principal functions: One was to develop needed Federal ADP standards; a second is to give technical advice and guidance to Government agencies; and the third is to perform necessary research.

The current program is addressing areas of major interest including:

Office automation; languages and software development; database technology; computer graphics; computer networking; hardware interfacing; flexible media such as disks; document interchange; and security procedures and technology.

They have provided leadership and guidance to the Federal Government in these areas, as well as informing and assisting the private sector. Work in each of these areas would be severely reduced or eliminated under the proposed reduction. ICST's role in providing guidelines and standards for the Government's use of computers and communications technology is cost effective and improves productivity for the Government.

The work that NBS does in the continued development of software test procedures, media testing, computer graphics and security could be seriously hampered. If this were to happen, there would be a proliferation of separate agency procurement specifications, which would lead to inefficiency and added cost in Government procurement of computers and in the operation of the computers once received.

Further, the proposed reduction of the ICST's budget would undoubtedly eliminate the key role the Institute has played in the development of standards for computer communication network interfaces and measurement techniques for testing computer protocol performance. Their work on test methods that support the development and implementation of computer network interface standards will assure that the computer products of different manufacturers will work together using international standards. This work must continue if we are to maintain a viable economy and a viable contribution in the world marketplace.

It has been suggested that the private sector could pick up some or all of the programs that would have to be dropped by ICST. We can appreciate the desire to transfer certain Government activities to the private sector. Indeed, we generally support that policy. But with all due respect to that point of view, we believe that the organization and mission of the ICST, and especially its neutrality and its nonproprietary technology, are not transferrable to the private sector to any significant degree.

It would take any private sector organization several years to reach the level of development and expertise that ICST currently has, and if and when that level were reached we seriously doubt that the neutrality and the nonproprietary aspects of the ICST programs would remain. Meanwhile, other countries of the world would be gaining on and surpassing us in these areas and, as I mentioned earlier, the loss of this centralized source of help to the

Government would create expense, less effectiveness, and mass confusion.

In particular, in a somewhat sidelight area, the help that the ICST can perform and provide to the International Trade Administration of the Department of Commerce in rationalizing export control criteria has often been overlooked and is a significant value to the industry when we work with the Commerce Department, DOD, and the intelligence community in trying to achieve a rational set of export controls so as not to hamper the export markets for our industry.

We feel very strongly about this. We think ICST is very important to the American productivity. As I mentioned at the beginning of my statement, our industry has contributed to a positive balance of payments in products and we have averaged better than $5.68 billion since 1979. Some of the downturn in the last year we suspect may have to do with the current dollar imbalance, but we would sincerely worry about a change in ICST's role to support the needed networking and telecommunications technologies to maintain our competitiveness.

We strongly urge that the budget for ICST be funded at least at the same level as fiscal year 1985 in 1986, and it seems to me that the expenditure of $10 million to more effectively utilize $14 billion in Federal information technology expenditures annually would be money well spent, even if we ignore the benefits to the private sector.

Thank you, Mr. Chairman.

[The following information was subsequently received for the record:]

QUESTIONS OF SENATOR GORTON AND THE ANSWERS

Question. Will reliance on voluntary standards—making organizations, such as the American National Standards Institute (ANSI), lead to substantial delays in establishing standards?

Answer. We believe that the voluntary consensus standards process is the preferred method of standards development because it is the only method that provides all interested parties (i.e. users, producers and general interest groups) the opportunity to participate in the development of standards. This wide range of participation insures that the resulting standard will be one that can be most useful and beneficial to all concerned parties.

It also helps to avoid development of standards by different groups covering the same subject matter that will be duplicative and conflicting with each other, resulting in products that can't be used together in a compatible way.

ICST has been a major contributor to the voluntary standards development process. As the representative of the Federal government, they represent one of the largest blocks of computing users in the world. Their participation helps to ensure that the necessary balance of interests in the standards development process is maintained.

Question. What unique role does the Institute play in voluntary standards development?

Answer. The role of ICST in voluntary standards development is unique in the following ways:

It is a critical national resource for focusing the Government agencies' requirements and representing these requirements in arenas where national and international standards are developed.

As a part of the National Bureau of Standards, it is uniquely situated to be an effective impartial negotiator in the standards development process. It promotes voluntary international standards that preserve U.S. industry's competitive positions in the world market while supporting users' needs for standards to achieve increased productivity and delivery of services at reduced cost.

Its continued development of software test procedures, media testing, computer graphics and security is a unique and valuable service to Government and industry.

Four examples of ICST's unique role are:

(1) Testing and certification of magnetic surfaces to assure that when a product is received it will work in a computer system. The work ICST has done in the development of standard reference materials for magnetic media (e.g., tapes, disks) is highly significant to the quality of American products around the world.

(2) Development of the Data Encryption Standard, DES, which provides for security in data communications in non-defense applications. ICST drew together the interested parties in the industry and produced the standard that is accepted now as a worldwide standard for data encryption.

(3) Development of network protocols and test methods. ICST has been playing a major role in the development of consensus standards for computer communication network interfaces and measurement techniques for testing computer protocol performance. This work will assure that computer products of different manufacturers will work together using international standards.

(4) Development of the information resource directory system (IRDS) standards. ICST drew together users and suppliers of IRDS software and produced the technical specifications which provided the basis for the proposed national and international standard for this important class of computer software system. ICST is currently working with industry to develop test procedures to support this standard.

In addition to its role in voluntary standards development, ICST plays a unique and invaluable role in providing guidelines and standards to help the government to improve productivity through the cost-effective use of computers and communications technology. The pace of new technology is growing so fast that this kind of help is essential. Without this central help, the other government agencies would be left to establish their own guidelines and standards. This would result in the proliferation of widely varying technical specifications used in procurements from separate agencies which would result in greater expense, less effectiveness and mass confusion in government procurement of computers and related services and supplies, and in the operation of the computers once received.

Question. Do you see a need for a private organization, initially supported by government seed money, to develop network standards and test methods?

Answer. We feel that no useful purpose would be served by creation of yet another private organization to develop network standards. In the U.S. this work is currently being carried out under the auspices of Accredited Standards Committees X3, Information Processing Systems, T1, Telecommunications, IEEE and EIA. The work of these organizations is being closely coordinated with the international work going on in ISO and CCITT. ICST represents the U.S. Government's interests in all of these activities.

ICST works effectively with both vendors and users in developing technical positions and advancing standards that serve both sets of interests. We see no reason to change a mechanism that works well.

With regard to test methods, ICST's work which supports the development and implementation of the computer network interface standards will assure that computer products of different manufacturers will work together using international standards. This work must continue. It serves the essential needs of preserving U.S. industry's competitive positions in the world market while supporting users' needs for standards to achieve increased productivity and delivery of services at reduced cost.

We do not believe ICST's work on computer network test methods, or any other part of ICST, should be transferred to a private organization. We can appreciate the desire to transfer certain government activities to the private sector. Indeed, we generally support that policy. But with all due respect to that point of view, we believe that the organization and mission of ICST, and especially its neutrality and non-proprietary technology, are not transferrable to the private sector to any significant degree.

It would take any private sector organization established for this purpose several years to reach the level of development and expertise that ICST currently has. If and when that level were reached, we seriously doubt that the neutrality and non-proprietary aspects of the ICST programs would remain. Meanwhile, the other countries of the world would be gaining on and surpassing us in these areas.

Question. Do you think the private sector would be willing to provide funds and technical personnel to support such an organization?

What magnitude of funding and number of technical personnel would you expect the private sector to commit?

Answer. At this time we see no evidence of long-term broadly-based financial support for this effort by the private sector. Industry is very much interested in the development of a single set of test methods for network standards. We believe ICST has the expertise, neutrality and non-proprietary interests to develop the most objective set of test methods. Once test methods are developed, we believe individual industry organizations should have the option of performing the tests themselves or having them done by a third party testing organization. This option may not be available from a private sector organization which has developed proprietary test methods. If funding or personnel from the private sector is to be considered then these would be most effective if they were channeled into the present ICST organization through the Research Associates Program.

Rather than taking the high-risk approach of attempting to privatize a part of ICST's program, we would encourage the Congress to seek a mechanism to formally recognize ICST's international standards role in support of U.S. industry, and to increase the resources available to perform this role. With increased resources and stable Federal funding, ICST will be better able to build increased cooperative efforts with industry.

Question. Would the U.S. role in developing international networking standards be weakened if the research, on which the U.S. position is based, was developed by users, or alternatively by vendors?

Answer. U.S. positions on international standards are developed with the participation of all interested parties, users, vendors, government, commercial. The broader the participation, the stronger the position. The U.S. role is weakened whenever the participation is not as broad as it should be. ICST has worked and should continue to work effectively with all interested parties in developing technical positions and advancing international networking standards that are useful and beneficial to all constituencies.

Question. If the vendors perform the standards work, is that work likely to be dominated by one or two companies? Would it adequately reflect the needs of the users?

Answer. CBEMA strongly supports the consensus approach to development of voluntary standards. This method provides all interested parties the opportunity to participate. As we stated earlier, this wide range of participation insures that the resulting standards will be most useful and beneficial to all concerned. ICST is an effective representative of users needs in this process. Its active participation helps to ensure timely development of needed standards.

Question. What level of funding would be required of the federal government over the next several years to maintain a first-class networking program in NBS? Is it reasonable to ask NBS to secure additional industry support in this area? Through what trade associations would such support be channeled?

Answer. Funding for networking activities has been stable or slightly increased since FY 1979. This in spite of the overall ICST budget reduction of 15% in FY 1983. In FY 1984 the networking program was funded at approximately $2.5 million. Funding was increased to nearly $2.7 million in FY 1985.

In its budget submission for FY 1979, the OMB requested $17.9 million in total funding for ICST. That level of funding would have permitted ICST to develop a comprehensive program of needed standards and guidelines across the high priority areas (including networking) identified in its five-year plan. Congress approved a budget of $11.3 million in FY 1979. ICST's funding was reduced to $10 million in FY 1983 and has remained frozen at that level.

ICST developed an effective program of work at the $11.3 million level of funding appropriated in FY 1979. An equivalent funding level, in current dollars, (approximately $15 million in FY 1986 dollars) would seem highly desirable for ICST.

Perhaps equally as important as *level* of funding is *stability* of funding. ICST will be better able to build cooperative, long term projects with industry if its budget is not in jeopardy every year. Obvious associations for increased collaboration include our own, CBEMA, as well as Computer and Communications Industry Association (CCIA), the Computer Security Institute (CSI), Association of Data Processing Service Organizations (ADAPSO), American Bankers Association (ABA), National Computer Graphics Association (NCGA) and American Society of Manufacturing Engineers (ASME). ICST already works with us and many more associations. In addition, ICST has and should continue to work directly with computer hardware, software, communications and services providers.

Question. Has the lack of funding increases affected the quality or level of research performed by the Institute?

Answer. As indicated in the answer to the previous question, ICST's funding level has placed constraints on the scope of its program. We believe the quality of the

work ICST has been able to do has been very good and is a tribute to the professional competence and dedication of its personnel.

Question. Do you feel there are research areas the Institute should be exploring but isn't because of lack of resources?

Answer. Given adequate resources, ICST could increase the scope of their efforts in these areas of major interest:

Office automation; software development; database technology; computer graphics; computer networking; hardware interfacing; storage media, such as magnetic and optional disks; document interchange; security procedures and technology; artificial intelligence applications; and development of testing methods for emerging software standards.

An area has often been overlooked is the help that the ICST can provide to the International Trade Administration of the Department of Commerce in rationalizing export control criteria. This is a significant value to our industry when we work with the Commerce Department, Department of Defense and the intelligence community in trying to achieve a rational set of export controls that will not hamper the export efforts of our industry, while maintaining our national security.

ICST is very important to America's productivity and its competitiveness with the rest of the world. Last year our industry contributed a positive balance of trade in the amount of $4.755 billion to the United States economy. America needs a strong standards program in the computer hardware interface, software and networking technologies to maintain or competitiveness in these areas. ICST has a key role to fulfill in development of the needed standards.

An expenditure of $10 million to $15 million to more effective utilize $14 billion in federal information technology expenditures would be money well spent even if we ignore the benefits to the private sector and our international trade posture.

Senator GORTON. Thank you very, very much.

Mr. Bush.

Mr. BUSH. Thank you, Senator Gorton. Mr. Chairman, and Senator Gore and Senator Riegle.

My name is John Bush. I am vice president of U.S. Gypsum Corp. and a member of the board of directors of the National Institute of Building Sciences. NIBS is an organization authorized by the Congress to advise Government and the private sector as to the proper use of building science and technology.

I appear here today to provide you with the building community's views on activities underway within the Center for Building Technology and the Center for Fire Research at the National Bureau of Standards, as expressed through the Institute's broadly representative consultative council. The National Institute of Building Sciences is a non-Government, nonprofit institution authorized by Congress in 1974. The Institute is charged by Congress with fostering improvements in building codes and standards in the United States through cooperation with the many entities that comprise the building community.

In addition, the Institute is authorized to promote the introduction and use of new and existing building technology—that is, products and systems—into the building process. One of the responsibilities of the Institute agreed upon by Congress was the gathering of data on current and future building technology research. In this regard, we have been working with the Center for Building Technology and the Center for Fire Research to interpret research programs determined to be significant by the building community.

Of note is the fact that the Bureau and the Institute entered into a memorandum of understanding on October 18, 1983. Pursuant to the memorandum, the Institute undertook an analysis of building community interest in programs underway at the Centers.

In May 1984, a preliminary list of 16 specific research recommendations was developed by the NIBS consultative council and forwarded to the Bureau of Standards for appropriate consideration. In October 1984 the Bureau provided a detailed response which demonstrated sound technical justification for the work underway at the Center for Building Technology and the Center for Fire Research.

Of the 16 recommendations provided by the Institute, 14 were being carried out by way of existing or planned research activity at the Centers. The two additional programs were to be studied further by the Centers for appropriate inclusion in future programs. This survey clearly indicated to us that the Centers were on target and responsive to the perceived research needs of the building community.

The issue before this subcommittee and before the Congress essentially are: Will the private sector or can the private sector replace the activities and research work being performed by these Centers?

To help myself answer that question, I talked to the research director of our special research department and to those of several other independent research groups and private industry, and they explained to me the answer is no, private industry cannot in reality realistically replace these services, because typically they involve first identifying a problem that needs to be solved by a measurement device of some kind, and then spending relatively large sums of money to develop such a testing device.

Once the device is developed, there are very few laboratories that need to purchase the device. So the numbers of customers for this type of test equipment would never justify the cost of the research work required to develop the equipment.

Perhaps the best example I can call to mind occurred about 4 years ago and is saving the U.S. consumer an estimated $95 million a year this year, last year, every year. What that was all about was the testing of thermal insulation materials for residential and commercial use, such as these rolls of insulation batting you see in television advertisements being rolled out in the attic of homes.

The only testing devices to determine the effectiveness of the thermal efficiency of these bats or blankets would measure 2 inches thick and that is as far as it would go, whereas typically these blankets are 4 to 6 inches thick. So companies were simply extrapolating from the 2-inch, that is, 6 inches would do three times as well.

The Federal Trade Commission decided that this was not an accurate way to do it and required that actual 6-inch thicknesses be tested. We have a mineral wool manufacturing plant in Tacoma, WA. We would have had to add 10 percent more product to all the insulation bat we made in order to assure we would not be fined—that is, my company—by the Federal Trade Commission for not accurately measuring.

Congress imposed or was able to prevail on the Federal Trade Commission to wait until the National Bureau of Standards, the Center for Building Technology, could develop a testing device before they made this mandatory. In the entire thermal insulation

industry, the addition of this 10 percent of product would have cost the consumer $95 million more a year.

Well, after about 6 months of work the Center did come up with such a new testing device which would measure the full thickness, and in this way they have saved, as I say, the consumer $95 million. This would more than pay and continues to more than pay their way.

So far as the Center for Fire Research is concerned, the most hotly debated issue, no pun intended, in the fire field today is how do we protect the occupants of buildings, through automatic sprinklers or through compartmentalization; that is, having different rooms where the smoke can not get in, the fire cannot get through the walls? This is being heavily promoted, this concept, by the plumbing industry of just replacing all of our rooms with sprinklers and not having fire-safe stairways necessarily and spending all the money to do that, that this is a tradeoff that will pay for the sprinklers.

Well, when you have a private industry dispute of this type going on we have to have an unbiased neutral referee. We have to have a lot of testing done on failures of sprinkler systems and other relevant data that are not known in making these decisions.

So summing the whole thing up, Mr. Chairman, the National Institutes of Building Sciences believes that these Centers are very important to our Nation and to our technical capabilities, and we certainly encourage their continuation. Thank you very much.

[The statement follows:]

STATEMENT OF JOHN S. BUSH, JR., ON BEHALF OF THE NATIONAL INSTITUTE OF BUILDING SCIENCES

Good morning. Mr. Chairman, members of the Subcommittee, my name is John S. Bush, Jr. I am Vice President of Government Affairs for the U.S.G. Corporation and a member of the Board of Directors of the National Institute of Building Sciences (NIBS), an organization authorized by the Congress to advise government and the private sector as to the proper use of building science and technology. I appear here today to provide you with the building communities' views on activities underway within the Centers for Building Technology (CBT) and Fire Research (CFR), at the National Bureau of Standards (NBS), as expressed through the Institute's broadly representative Consultative Council. Accompanying me is Brian R. Landergan, P.E., Senior Vice President of the Institute.

The National Institute of Building Sciences (NIBS) is a non-government, non-profit institution authorized by Congress in 1974 as part of the Housing and Community Development Act, (P.L. 93-383). The Institute is charged by Congress with fostering improvements in building codes and standards in the United States through cooperation with the many entities that comprise the building community. In addition, the Institute is authorized to promote the introduction and use of new and existing building technology (products and systems) into the building process.

One of the responsibilities of the Institute agreed upon by Congress was the gathering of data on current and future building technology research. In this regard we have been working with the National Bureau of Standards (CBT/CFR) to interpret research programs determined to be significant to the building community.

Of note is the fact that the Bureau and the Institute entered into a Memorandum of Understanding on October 18, 1983. Pursuant to that memorandum, the Institute undertook an analysis of building community interests in programs underway at CBT and CFR. In May 1984, a preliminary list of 16 specific research recommendations was developed by the NIBS Consultative Council and forwarded to NBS for appropriate consideration. On October 19, 1984, the Bureau provided a detailed response which demonstrated sound technical justification for the work underway at CBT and CFR. Of the 16 recommendations provided by the Institute, 14 were being carried out by way of existing or planned research activity. The two additional pro-

grams were to be studied further by the Centers for appropriate inclusion in future program planning.

It was interesting to note that many projects considered to be of value to the building community were underway at NBS. This was an indication that CBT and CFR were on a proper course, responding to research needs seemed important to the building community. For the benefit of Subcommittee members and staff, we have appended a list of our early recommendations and the Bureau's written response to this statement (see Appendix A).

In keeping with our contractual agreement, which is a small contract for professional advice, the Institute conducted a second survey of the building community in December of 1984, and January of 1985, seeking new priority suggestions for needed research activity in building technology. Survey responses have been quite revealing and shortly our survey results will be made available. Based upon the surveys received, a need exists for research activity in areas relating to:

Durability of materials; dynamic loading of structural materials; moisture degradation in warm and humid climates; racking strength for panelized construction elements; coatings for fire resistance and flame spread; toxicity testing and data for fire and smoke hazard assessment models.

Far more detail is available, but early results show a definite industry concern for material performance and life safety.

The Institute believes that when Congress established the National Bureau of Standards, it did so in recognition of the need for government leadership in fostering scientific advancement. In that context, the Centers for Building Technology and Fire Research are essential parts of an overall framework intended to improve the quality of the built environment.

Consistent with NBS authority to cooperate with other government and private entities, develop methods for testing materials, and advise the public on technical matters, it appears that CBT and CFR are fulfilling their mission in a responsible way. As evidence of the cooperation and constructive discourse now seen at CBT and CFR, are Memoranda of Understanding in effect between NBS and HUD, DOE, NSF, OSHA, NCSBCS, and NIBS. Such communication and technical exchange as provided for in these memoranda is vital in the interest of joint program planning and avoidance of duplicative program effort. In that regard it has been reported that nearly 70 percent of the work undertaken by the Centers, is for other agencies of government.

On the horizon, we see many new areas in which CBT and CFR can provide valuable assistance to the building community. In the context of specific recommendations that will shortly by submitted to these Centers and this Subcommittee, new work in thermal analysis of complete wall and roof assemblies should be pursued. In addition, more emphasis is needed on seismic design and retrofit strategies for older buildings. NIBS has worked directly with NBS in the former case and, through the Building Seismic Safety Council, a voluntary technical organization formed under the aegis of the Institute, in the latter. In each case the Bureau (CBT) has supplied valuable technical data.

Specifically, at CBT, it is our view that fundamental work should continue in: structural engineering; material durability and performance; construction safety; thermal analysis of whole systems; mechanical systems and controls; basic building materials.

And, at CFR, in: fire risk analysis; fire safety performance; suppression & extinguishment; smoke and toxic gases; fire-properties of materials.

As a result of our recent working relationship with CBT and CFR staff, we have become appreciative of their work and we recommend maintenance of program funding in the suggested areas. The loss of the work now being performed at these Centers would be damaging to the nation's construction industry that has come to rely upon these Centers for thorough and objective data, and for services available nowhere else. We endorse current work within CBT and CFR and we will be certain to provide this Subcommittee with continuing reports on our research recommendations which evolve through our survey efforts, and consensus process.

Other efforts underway at the Bureau will have a significant impact on the building industry if they are terminated. In particular, CBT provides a focal point for those interested in data and information on international standards. We have long recognized that harmonization of international standards could enhance our ability to export building products. Efforts in this area have yet to be effectively coordinated and we believe that NBS could assist such an activity in a meaningful way.

As we have previously stated, the programs at CBT and CFR should be continued and are best supported and fostered by non-proprietary interests. In this way, research results and programmatic accomplishments are available to all on an equal

basis. Our belief is that these Centers help stimulate new technological developments and speed their use in design and construction practice, as a result of open public disclosure, where new information and ideas may be further advanced by innovative individuals and corporate interests.

The National Institute of Building Sciences is concerned about the continued focus on these two Centers that, according to peer groups, are performing valuable services for the building community. As time passes, we are becoming aware that many activities undertaken by these Centers will not and cannot be supported by proprietary interests. The dilemma confronted by this Subcommittee is real . . . particularly now, when faced with huge budget deficits and a situation of deciding which public programs should be dissolved. The Institute recognizes the dilemma and we can only voice our concern for the carrying out of identified public interest research projects if funding for CBT and CFR is discontinued.

Mr. Chairman, we appreciate this opportunity to present our views and our survey results. We will continue to monitor the work of these Centers and submit our findings to you for review. We trust that our efforts to evaluate the work of NBS will be of use to you in your decision-making process.

thank you.

Attachments.

NBS RESPONSE TO NIBS RESEARCH RECOMMENDATIONS

The following describes current Center for Building Technology (CBT) and Center for Fire Research (CFR) efforts in areas recommended by the National Institute of Building Sciences.

1. ACCELERATED TESTING FOR DURABILITY OF BUILDING MATERIALS

CBT has established leadership in accelerated testing of building materials through its development and demonstration of innovative approaches to service life prediction and its strong interactions with the national and international building communities. Two projects are underway:

A. Application of Life-Test Analysis Concepts to Building Materials

Reliable prediction of service life is needed to aid the selection and use of polymeric building materials. But major technical barriers to the development of predictive models arise from the complexity of the degradation processes, particularly the synergistic effects of ultraviolet radiation, temperature, moisture, and other factors. Currently, predictive models and accelerated tests do not account for this interaction. CBT is developing stochastic models incorporating synergistic degradation effects. These models are being validated against laboratory and outdoor test data. Advanced accelerated aging techniques are part of this research effort.

Prior research has led to the development of a stochastic model as a function of two of the above degradation factors (ultraviolet irradiance and temperature) using polymethylmethacrylate (PMMA) as a model material. The model is being extended to include moisture. PMMA specimens are exposed to several relative humidity levels, keeping irradiance and temperatures constant. Degradation is modeled in terms of the chemical and physical changes occurring within the material. The project is aimed at putting durability-related evaluation methodologies on a probabilistic basis by providing an improved service-life predictive model and demonstrating an approach that can be used with a wide range of building materials.

B. Organic Coatings

This research focuses on extending and refining mathematical models and developing improved laboratory test methods to characterize performance properties of coatings. Improved tests are needed to aid development of an ASTM standard for prediction of service life of coatings. The results will be incorporated into standards through interactions with ASTM committees D1 on Paints and Coatings. The findings will also be used in assisting FHWA, military and other government agencies in selecting corrosion protective coatings for steel. Overall, the development and validation of predictive models and the development of improved characterization tools will provide the technical basis for improved selection, use and maintenance of protective coatings.

2. AIR AND MOISTURE MOVEMENTS WITHIN INSULATED WALL SYSTEMS

Several CBT projects are underway which address this recommendation.

A. Calibrated Hot-Box Conduction Transfer Functions

The CBT Calibrated Hot-Box apparatus is being calibrated to determine measurement errors due to heat loss through flanking paths. A series of calibration tests are being performed for steady state and dynamic temperature differences between the indoor and outdoor sides of the wall to determine heat, air, and moisture transmission rates. During FY85, CBT's efforts focus on calibration work and planning a series of experimental test walls that will be designed to investigate parameters such as convection within voids in the wall cavities, thermal mass, and to validate models used to predict performance under a variety of exposure conditions. CBT's participation in a 20-30 laboratory round-robin test program determines the repeatability and uncertainty in the ASTM 976 method of test.

B. Convective Air Movement in Buildings

An NBS computer model has been developed which is capable of simulating the natural convection heat transfer between room surface and adjacent air, natural convective heat transfer between adjacent rooms, and the forced convection between the building and its external environment. The adequacy of this model will be assessed for developing predictive capabilities in areas such as convective heat transfer in insulation systems, the dispersion of contaminants in rooms (ventilation efficiency), and the interzone movement of air.

C. Field Wall-Component Tester

This project is to develop a field method for measuring the thermal conductance of wall components under transient conditions. Presently it is difficult to measure the thermal response of wall components under typical field conditions caused by diurnal climate changes. Existing field methods require large temperature differences and no reversal of heat flux which restricts their use to cold winter months and to surfaces without solar loading. CBT designed a portable calorimeter box to permit measurement of the thermal conductance of wall components under typical transient conditions.

3. BUILDING EQUIPMENT AND CONTROLS

CBT work in this area includes.

A. Systems and Controls Laboratory

This research is developing mathematical models and measurement techniques for evaluating the performance of building systems and controls, encouraging energy conservation in buildings through dissemination of improved control strategies and software, and developing guidelines for automated building management systems. This effort complements CBT's DoE-sponsored research aimed at documenting the energy savings potential of the most commonly employed HVAC

control strategies, developing algorithms for building control systems, evaluating the reliability of automated building management systems, and studying the application of sensors in energy monitoring and control systems.

CBT is installing a complete Energy Management and Controls System (EMCS) in the NBS Administration Building and carrying out research with the system to verify and refine the building/HVAC/control system simulation model and the EMCS application algorithms developed in FY 83 and FY 84. In addition, the integration of building services through the use of simultaneous voice and digital communication systems will be explored.

B. Test Methods and Evaluation Procedures for Solar Controllers

The field performance of many active solar systems has been poor. Data from instrumented sites indicate that approximately 40% of the monitored systems performed at one-half or less of design expectations. System controllers and their associated sensors were identified as the least reliable solar components in various studies of field problems.

In FY 84, CBT initiated the development of a research plan for developing test methods and evaluation procedures for controllers. This plan outlines the types of controllers to be studied, and various tests (functional, environmental, electrical, sensor interface, etc.) to be performed. Existing test methods are under review. The plan is based on the results of studies conducted at NBS and SERI and includes recommendations from industry and other organizations. A preliminary draft plan as been circulated for review and comments. When completed, the plan will provide the basis for CBT's laboratory research program. The plan also identifies industry and standards-writing organizations that should be involved to process the recommended test methods and evaluation procedures into national consensus standards.

C. Controls Dynamic Modeling

None of the current building simulation programs (e.g., BLAST 2, DoE 2) accounts for HVAC control dynamics. As a result, there exist few reliable evaluations of the amount of energy waste in buildings due to control dynamics and little information on how to design and operate building control systems to optimize dynamic performance. This research concentrates on developing simulation models to predict the dynamic, "minute-by-minute" performance of control systems for building air handlers and heating/cooling plants. The building HVAC/control system simulation program includes models for building equipment, HVAC components, controls, zones, and the building envelope. Current work concentrates on verifying and refining models of the various components found in building air handlers, and developing a simple building shell model and an interactive user interface for the building/HVAC/control system simulation program.

D. Energy Monitoring and Control System Algorithms

At present, there are no standard, nonproprietary EMCS application algorithms available for use by companies entering the building controls field. Many EMC systems often do not work or only partially work.

CBT is developing public-domain algorithms for HVAC/building applications. Past work concentrated on the completion of algorithms for the control of building air handlers, including optimal start/stop, scheduled time of day stop/start, duty cycling, demand limiting temperature reset, and economizer cycle. CBT is validating and refining air handling algorithms and expanding this effort to include the development of algorithms for the control of centrifugal chillers.

The development and dissemination of validated public domain algorithms for EMC systems should lead to greatly improved EMCS performance, especially for systems made by small manufacturers, resulting in increased energy conservation in commercial buildings.

E. Heat Pump and Air-Conditioner Test Procedures

The Energy Policy and Conservation Act (PL 94-163) and the National Energy Conservation Policy Act (PL 95-619) require the Department of Energy to prescribe test and rating procedures and minimum performance standards for various residential appliances, including central heat pumps and air conditioners. DoE has, since 1975, relied on CBT to assist in the development of the test procedures. Also, DoE has supported the verification of these test procedures and the extension of their scope to include new designs coming onto the market. Also, since the current procedures have not addressed the case where the components of a given system may be manufactured by different companies and assembled in the field (e.g., replacement air conditioner), DoE has directed CBT to develop a procedure by which these units may be rated. This work encourages energy conservation affecting virtually all new-production residential heat pumps and air conditioners in the United States.

4. ENERGY COST-BENEFIT STUDY FOR MANUFACTURED HOMES

No CBT related work underway. DoE has funded Steven Winter Associates, New York, for related work.

5. HEAT AND MASS TRANSFER

Several CBT projects focus on this topic.

A. Convection Within Low-Density Insulation

The one-meter Line-Source Guarded Hot Plate apparatus recently developed at CBT is used in this research because different directions of heat flow (up, down and horizontal) can be applied to insulation materials as thick as 15 in. Here, specimens of different thickness are used with differential temperatures controlled up to 104°F to determine differences in measured thermal transmittance

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(resistance) when the plates are rotated to give different directions of heat flow. The differences of thermal resistance between heat flow down and heat flow up determine the convection effect for each test. Quantitative measurements are provided to determine convective effects and this information is delivered to practitioners, industry, and organizations such as ASTM and ASHRAE.

B. Heat-Flux Meter Characteristics

Heat flow transducers are comparative measuring devices which must be calibrated or referenced back to an absolute measurement. Large errors in calibrations due to the way the transducers are used are prevalent. These transducers are used extensively in research, measurement, and production work. Precision and accuracy in this type of measurement need improvement so that resulting test method specifications are similarly dependable.

In this project, a method or methods for calibration of heat flow transducers are devised and validated using the NBS guarded hot-plate apparatus as the source for absolute quantitative data. Comparisons are being made with data obtained from other methods or devices such as the CBT calibrated hot box or techniques used by other laboratories. A study of errors for both laboratory and field applications are being made with a view to developing remedial procedures to minimize errors.

C. Thermal Resistance Calibration Standard

This project explores the feasibility of developing a new calibration standard for thermal resistance measurement equipment such as guarded hot plates (ASTM C-177) and heat flow meters (ASTM C-518). At present two materials are available from CBT for calibrating guarded hot plates and heat flow meters. One is a dense fiberglass board and the second is a low-density fiberglass blanket. A need exists to supply the measurement community with calibration samples whose apparent thermal conductivity and thermal resistance are both higher and lower than those now available, using materials that more nearly resemble those that will be measured in current production or using an entirely new calibration material approach; for example, plastics, insulating concretes, loose fill materials, or something like a honeycomb type of material, whose thermal conductivity could be changed at will. Given success in this venture, a measurements laboratory desiring calibration would have the flexibility for calibrating their devices at or near the several ranges of thermal conductivity and temperature values expected to be measured, thus improving the precision and bias of their standard test methods. Much money will be saved by the manufacturing industry if production machines can be set more precisely to produce the R-values required. This, in turn, will lower prices to the consumer.

D. Envelope Thermal Testing Unit

This project, is to determine the usefulness and accuracy of the envelope thermal testing unit (ETTU) developed by the Lawrence Berkeley Laboratory for the Department of Energy. The device is being used on CBT field projects to determine the practical problems and field sources of errors resulting in its use. Guidelines were developed for the use of ETTU. Measurements from the

six thermal mass buildings were compared with the known thermal resistance of these walls. A series of test walls of typical construction were built and installed in a small test cell in the NBS environmental chamber. Measurements were made on these walls under various simulated thermal conditions. From these tests the accuracy of ETTU was determined under various environmental conditions. The source of error was determined and the results compared with those of other test methods.

E. Field Measurements of Wall Thermal Mass

Six 20-foot wide and 20-foot long, one-room test buildings (modules) were constructed and their seasonal heating and cooling performance was studied at the NBS Site. All six test modules have the same floor plan, orientation and other common features. The wall constructions are:

1. Insulated light-weight wood frame
2. Uninsulated light-weight wood frame
3. Insulated masonry (mass exterior to wall insulation)
4. Uninsulated masonry
4. Log
5. Insulated masonry (mass interior to wall insulation)

These six test buildings were extensively instrumented for measuring the wall heat transmission, heating and cooling energy consumption, and the indoor comfort condition. A comprehensive series of field measurements have been carried out to date including:

- o 14-week winter measurements with the thermostat set for space heating at 68°F
- o 3-week spring measurements with the thermostat set for space heating at 68°F
- o 3-week summer measurements with the thermostat set for space cooling at 76°F
- o 14-week winter and spring night temperature setback measurements
- o 3-week summer measurements with the thermostat set for space cooling at 65°F
- o 3-week summer measurements with night ventilation used during cool night periods
- o Special purpose winter, spring, and summer partition wall tests.

The data obtained during this series of tests demonstrated the effectiveness of thermal mass on heating equipment only under mild climatic conditions and cooling requirements for all the climatic conditions. CBT provided representative data files of measurements of the six thermal mass test buildings covering all of the periods of measurement. The data file is being used by LBL to validate BLAST.

6. LOW-SLOPED AND FLAT ROOFING SYSTEMS

CBT's research is described under the following projects:

A. Thermal Performance of Low-Sloped Roofs

In this research a method to quantitatively determine the thermal performance of low-sloped roofs is being developed. Parameters required to characterize roofing thermal performance are being identified. Some of the factors which may affect the total thermal performance of the roof include: the composition (components) of the roof, type of insulation, joints between insulation boards, the amount of moisture in the roof, the number of penetrations in the roof, and the environment to which the roof is exposed. The method includes mathematical models for assessing thermal performance and in-situ thermal measurements of roofing systems. Recommendations concerning an on-the-roof test method are being performed, and research needs for implementation of the methodology are being identified. Recommendations also are being made as to ways to shorten the time required to measure in-place thermal performance. Recommendations on how to estimate the thermal performance of the Nation's inventory of low-sloped roofs from data for a relatively small number of roofs are being made.

B. Bonded Seams in Single-Ply Membranes

This research provides the technical basis needed to develop or select a test method which reliably predicts the field performance of seams in single-ply membranes. CBT is assessing the adequacy of existing requirements given in standards and specifications for single-ply sheet roofing materials. The assessment will provide a technical basis for preliminary criteria and guide specifications for single-ply membranes.

C. Probabilistic Study of Single-Ply Membranes

In developing and demonstrating a probabilistic method for predicting service life of single-ply roofing membranes, membranes will be subjected over time to both mechanical and thermal stresses. Time-to-failure distributions will be obtained for each experimental condition (minimum of three temperature levels and three mechanical stress levels). The degree of functional dependence of the time-to-failure distribution parameters on temperature and mechanical stresses will be determined through time-temperature superposition and time-mechanical stress equations. Other experimental variables which are being used include membrane characteristics (seam, no seam), and characteristics of the thermal insulation (gap and no gap between insulation boards, insulation and no insulation). Both creep and stress relaxation experiments will be

performed. EPDM (ethylene propylene diene monomer) is being used as the first test membrane material, representing the rubber-like, single-ply membrane family. Other membrane materials which may be used in future studies are modified bitumens, thermoplastics, and other rubber-like materials.

7. SOUND INSULATION AT LOW FREQUENCIES

CBT's research includes:

A. "Evaluating Sound Insulation Properties

The need for the development of test methods for low frequency sounds was identified by CBT in the report, Noise Criteria for Buildings: A Critical Review, NBS Special Publication 499 (p. 32 and pp. 37-39). Following this publication, a psychoacoustic research program designed to assess from a human response viewpoint the sound insulation of simulated party walls was developed and partially implemented in a joint Centre Scientifique et Technique du Batiment and CBT (CSTB/CBT) program. The work culminated in the publication of a joint CSTB/CBT report.

B. Measuring Acoustical Quantities in Buildings

CBT's acoustical research places emphasis on the development of accurate, reliable, and unambiguous methods for measuring acoustical quantities in buildings. CBT took advantage of advances in digital signal processing techniques, and of the known relationship between acoustic intensity and the imaginary part of the cross-spectral density between the output of two closely spaced microphones, to develop a capability for measuring acoustic intensity directly rather than inferring it from measurement of sound pressure using diffuse sound field theory. The sound insulation of a partition in a specified frequency band is by definition the ratio, expressed in decibels, of the airborne sound power incident on the partition to the sound power transmitted by the partition and radiated on the other side. Since the acoustic intensity is the acoustic power flowing per unit area, it follows that the acoustic intensity method can be used to develop a test for determining the acoustical insulation of walls based upon measurement of the incident and transmitted sound intensities. This is an important development because the current ASTM and ISO standards require that the sound insulation of a partition separating two rooms be determined by first measuring the difference in the space-time average sound pressure levels when a sound source is introduced in one of the rooms (the receiving room), and then "correcting" this level difference for the acoustical properties of the receiving room. To obtain the "correction term" the decay of the sound field in the receiving room must be determined. However, this measurement, as typically performed, yields ambiguous results. Another major problem with the current practice is that the level difference requires adequate spatial sampling of the mean-square sound pressure in each room. At low frequencies the spatial variance of the mean-square pressure is large because of the low modal overlap that results from low modal density. Moreover, to obtain independent sampling of the sound field, microphones must be located at least half a wavelength apart at each frequency of interest. Since the wavelength is inversely proportional to frequency, the wavelength of sound at frequencies

below 125 Hz approaches the dimensions of typical rooms. Accordingly, one cannot find a sufficient number of microphone locations to ensure independent sampling of the sound field. These are major reasons why the sound insulation characteristics of partitions at low frequencies are not measured. The acoustic intensity technique may allow us to circumvent this problem if we are able to devise an accurate procedure for accounting for the phase mismatch between the analog parts of the two-microphone channels as this is a major source of error in acoustic intensity determinations at low frequencies. We are currently working on this problem. CBT's acoustic intensity work is expected to yield a valid measurement method for performing sound insulation measurements not only in the normally accepted frequency range (125 - 4000 Hz) but also at lower frequencies.

8. THERMAL ANALYSIS

CBT's research includes three projects.

A. Multi-Room Thermal Modeling and Large Building Air Movement

This project is developing a comprehensive technique for predicting simultaneous transfer of air, moisture, and heat in and through multi-room buildings. Although numerous building thermal modeling techniques and computer programs exist throughout the United States, none of them can handle the following processes simultaneously: envelope heat transfer, envelope air leakage, envelope solar heat gain, room-to-room heat transfer, room-to-room air and moisture transfer, intra-room air movement, energy consumption by the heating/cooling equipment, indoor comfort, water-vapor condensation, and contaminant migration. Existing models are usually single-room models and dynamic coupling between the heated/nonheated spaces and/or the cooled/noncooled spaces are ignored.

CBT has developed the Thermal Analysis Research Program (TARP) which has been validated by the experimental results of the six test houses at the NBS Site. This program is capable of performing the simultaneous analysis of air and heat transfer in multi-zone structures and the interzone movement of contaminants. Various scaling relationships will be examined to permit small scale models to be used to simulate actual full scale heat and mass transfer. Data from these small scale models are being used to validate the accuracy of TARP to simulate complex heat and mass transfer.

B. Wall Systems Air Leakage Research

A test method is being developed for measuring the efficiency of ventilation in modern commercial buildings. This method determines the minimum amount of air exchange which is effective in removing contaminants from the work space. The method is based on the injection of a tracer gas into various zones of the building initially developed in CBT for application to large buildings for the determination of the buildup and decay of the tracer gas in the work space and in the exhaust air. Tests were made in three different commercial buildings and the results used to determine the effectiveness of the ventilation systems.

Air infiltration and ventilation data are being collected on three additional commercial buildings which have passive solar design features and large atria, in order to increase the data base on large buildings. If possible, fan-pressurization tests and tracer-gas tests will be performed on additional buildings to assess their air leakage characteristics.

C. Evaluation of Thermal Anomalies

This project investigates the adequacy of in-situ methods for quantifying heat losses due to thermal anomalies. The quantificative use of thermography is being assessed for both the measurement of temperature and heat flux. Laboratory tests are being performed on representative thermographic systems to determine their characteristics for making quantitative measurements. The in-situ use of heat flow meters and calorimeters is being investigated. Guidelines will be established for each of these methods and an assessment of their accuracy will be made.

9. DEVELOPMENT OF INTEGRATED BUILDING FIRE RISK PREDICTION PROGRAM MODEL FOR CODE AND REGULATORY PROGRAMS

A CFR project is underway to further the development of methods for the quantitative measurement of fire risk; i.e., the probability and magnitude of fire caused harm to life, property, or operational capabilities. Probabilistic functions will be integrated into both the key variables of the emerging deterministic models and the choice and weighting of individual simulations executed by those models. The risk measurement form of the models will apply the deterministic models in the stochastic environment of reality to predict the likelihood of selected types of harmful impact (e.g., death, injury, property loss) of a given entity (e.g., building, operation, use) and the change in this likelihood caused by selected mitigation actions. The development of the structure will require attention to each element within the overall model (e.g., ignition, spread, growth, human reaction, tolerances, damageabilities, etc.). The inclusion of stochastic considerations will require the development of a process for assigning values to critical variables according to fire scenario and a process for weighting each scenario. This process may involve Monte Carlo techniques.

10. DEVELOPMENT OF INTEGRATED BUILDING FIRE SAFETY SIGNALING SYSTEMS

No CFR related work underway.

11. EVALUATING BUILDING FIRE PERFORMANCE OF MATERIALS AND ASSEMBLIES BASED ON SMALL SCALE FIRE TESTS AND MODELING

Fire growth and spread and smoke toxicity hazard models are under development that will permit the fire performance evaluation of materials and assemblies for buildings in a rapid and economical manner. Fire property measurement methods are also under development and refinement to provide necessary data inputs to the models.

First models that estimate safe egress time and time to hazard on a single floor are in limited use by fire protection engineers. A new, fundamentally based, fire growth and spread model is under development.

Measurement methods, such as the cone calorimeter which measures rate of heat release using the oxygen consumption method, are in various stages of development.

12. HOUSING/APARTMENT SAFETY FOR THE ELDERLY

A joint project with NRC of Canada on smoke movement and control in elevator shafts will be of particular benefit to the elderly in escaping fires in high rise apartment buildings. Currently, elevators are not used for fire escape.

The objectives of the project are to (1) develop concepts of elevator smoke control systems based on computer analysis using a network airflow analysis model, (2) verify the basic assumptions of network airflow models for elevator smoke control analysis by means of non-fire airflow tests using the Canadian experimental fire tower, and (3) demonstrate the effectiveness of elevator smoke control by means of full scale fire testing.

Further, the work on Fire Safety Evaluation Systems (FSES) for board and care homes will directly impact on that type of housing for the elderly. The FSES will permit the evaluation of the level of fire safety of the housing unit in comparison to an established code such as the Life Safety Code.

13. NBS RESEARCH RELATED TO PERFORMANCE AND HAZARD ASSESSMENT OF SOLID FUEL HEATERS AND THEIR CHIMNEYS

CFR is currently studying hazards related to the installation, operation, and maintenance of solid-fuel burning appliances and their chimneys. Ongoing research in the areas of masonry fireplaces and/or chimney systems, alternate lining systems for masonry chimneys, and coal burning appliances will add information in these areas. Full size appliance and chimney systems, exposed to outside winter conditions and operated over a range of conditions, will provide a base of data for designers and code officials.

Research completed addressed hazards arising from insufficient clearances between appliances or chimneys and surrounding combustibles and from creosoting and chimney fires in factory-built chimney systems.

The results of the research provide data on the intensity and duration of chimney fires and on clearances and methods of protection for combustible surfaces exposed to radiant heating from solid-fuel heating appliances and their chimneys.

14. STUDY, TESTING, AND DEVELOPMENT OF GUIDE APPLICATION CRITERIA FOR SMOKE MOVEMENT, CONTROL, AND REMOVAL SYSTEMS

In FY 84, CFR developed and published (through ASHRAE) an engineering design manual for smoke control systems. Current activities include:

1. The development of a detailed procedure for test and evaluation of the performance of building smoke control systems, suitable for use as an acceptance test for new systems.

2. Theoretical and full-scale experimental program on smoke control for elevators to allow their use for the evacuation of the handicapped during a fire emergency (with National Research Council of Canada).

15. TOXIC HAZARD ASSESSMENT OF BUILDING MATERIALS AND FURNISHINGS DURING A FIRE

The goal of the current toxic hazard assessment program in CFR is to develop a computer model which can quantitatively evaluate the potential hazard to occupants from a fire in large, multi-story buildings. Fire hazards assessed include thermal (both temperature and radiant flux), smoke obscuration, and toxicity. At present, a first-order model which can be used for multi-compartment, single-story structures has been developed. Work to extend this model to multiple stories, add forced convection, and include incapacitation and occupant evacuation is ongoing. Associated projects include the development of test apparatus to obtain the necessary property data and the compilation of existing data for use in these models.

16. DELIVERY SYSTEMS FOR CBT/CFR RESEARCH RESULTS

The Centers' research findings are disseminated broadly to the Nation's building community. Direct interactions are maintained with Federal agencies, designers, developers, builders, manufacturers, professional and technical societies, the research community, building regulators and standards organizations. Technology transfer is accomplished through workshops and conferences, responding to inquiries, producing reports on research, presenting technical programs to industry, serving on over 340 technical voluntary standards generating committees, holding memberships in domestic and international professional societies and chairing committees and subcommittees of professional societies, and providing technical contributions to professional and scientific journals. CBT conducts a monthly workshop on building science and technology to promote communication and coordination in building technology, and CFR conducts a three-day annual fire research conference that reaches over 250 leading researchers and practitioners of the fire community.

CBT and CFR, in turn, learn from the building community about their needs for new research in building science and technology. Building community needs for improved technology are identified for evaluating and preparing technical solutions. Special communication methods are developed to deliver technical information for immediate application by designers, builders, and owners. CBT and CFR publish general purpose reports that summarize their ongoing research, provide listings of publications, descriptions of their unique facilities, and opportunities for guest researchers. These Centers have over 10 Memoranda of Understanding to provide technical support to public and private sector organizations, such as NIBS, NCSBCS, PBS, Air Force and NSF, that lead to improved building practices for more useful and economical buildings.

Senator GORTON. Mr. Bush, I will ask a question of you first. The National Institute of Building Sciences has a memorandum of understanding with the Bureau to help guide CBT and CFR research priorities. Is this something which is going to be an ongoing process or a one-time thing?

Mr. BUSH. The National Institute of Building Science, the answer is "Yes," it is ongoing. It is annual. We are represented by all interests of the diverse building community and we are in a good position to poll the overall—all the disparate functions and factors in that industry and inform the Bureau of Standards of what is needed out there in the real world.

And this is an ongoing annual project.

Senator GORTON. Mr. Gerard, your statement speaks of the proposition that eliminating the Center for Fire Research would run the risk of having fire safety being determined in the courtroom, not the laboratory.

Explain that. Does that mean that you would not be able to come up with your voluntary safety standards; that they would be totally undermined? And, finally, are you in a position now where the standards are not being set in the courtrooms?

If so, you are pretty fortunate.

Mr. GERARD. Well, I believe that there is probably no way to keep some of the modifications of standards out of the courtroom. I suspect as long as there are lawyers, there will be lawsuits.

Senator GORTON. I suspect that is true.

Mr. GERARD. And a diminution of that. But I suspect that it will continue. And our concern is that without objective research, without research that demonstrates what does work, what does not work, what is good, what is not good—as an example, Mr. Bush mentioned sprinklers. There are people who would say sprinkle everything and you do not have a problem.

Then there are others who say that is not the answer. And so if you had a loss of life in an unsprinklered building, you could perhaps decide, well, let's sue because they have not spinklered this building.

Conversely, if you were on the top of the MGM Grand Hotel and it was sprinklered and you did die on that floor because the sprinklers did not go off, perhaps you could file a lawsuit that held you put in sprinklers but they don't work.

And so there are two sides to the issue, and the research is just beginning. The concept of the fast response sprinkler head, for example, is new technology and there is a lot of research needed on tradeoffs. There are several places in the United States where if a developer will install a residential sprinkler system, they don't have to put in firewalls, they don't have to do this, they don't have to do that.

I am not comfortable with some of that as a fire authority. I am not comfortable with that being done. It is being done by fire people. But I am not comfortable with that because we are giving up built-in protection without knowing that it is safe. And I think that research needs to be accomplished that would identify if you sprinkler this occupancy, you can trade of this, you can reduce this amount of protection or that amount of protection because the sprinklers will take you this far. They don't take you all the way.

We don't know what the limit of that is. And I believe that the most expensive way—and that is basically what our testimony says—the most expensive way to accomplish that is in the courtroom. It is much more cost-effective, much more practical, there is much less loss of life and property if it is done through research.

Senator GORTON. Thank you.

Mr. Henriques, you point out the important role the Institute plays in providing guidelines and standards for the Government's use of computers and communications technology. Is there any organization in the private sector which would be able to take the lead in coordinating and communicating with the Federal agencies to determine the need for Federal standards and guidelines?

Mr. HENRIQUES. Not to my knowledge, sir. I don't believe there is one.

Senator GORTON. Would one come into existence if this budget were adopted?

Mr. HENRIQUES. I think it is doubtful. I think the glue that holds the Federal ADP program together, the Federal Information Processing Standards System is the Institute for Computer Science and Technology. And if it were not at the National Bureau of Standards, then it would probably have to be in some other Federal agency, not in the private sector.

Senator GORTON. What would be the impact of the discontinuance of the type of research which would be cut out by this budget on your members?

Mr. HENRIQUES. Well, I can cite at least two I think very hard examples. One is the work that the Bureau has done and continues to do in the area of media; that is, magnetic surfaces; the testing and certification of magnetic surfaces to assure that when product is received it will work in a computer system.

That leadership, the work that they have done both in the instrumentation tape and in the computer tapes is highly significant to the quality of American products around the world.

A second example is in the generation of the Federal encryption standard, the so-called DES [data encryption standard], which provides for commercially secure, not nationally secure, but commercially secure computer facilities. Had that not been brokered as it were, or judged by the Bureau of Standards, there probably would have been a terrible commercial competitive fight, for one brand versus another.

As it was, the Bureau drew together the different factions in the industry and produced the standard that is accepted now as a worldwide standard for data encryption. And I think those are examples of the kind of thing that the Bureau can do that would not be done if this program were cut down.

Senator GORTON. Thank you. I have a number of additional questions for each of the three of you. But I will defer to the other Senators and submit those in writing because we do wish to produce an authorization bill promptly, so we appreciate your careful and prompt attention to them.

Senator Riegle.

Senator RIEGLE. Thank you, Mr. Chairman.

On the very line of questioning that you were pursuing with respect to the Institute for Computer Science and Technology, I also

am very concerned about what happens if we dismantle the effort that we now have to let the Federal Government work as a competent impartial referee to come up with standards that can then be followed.

I was noticing in the report of the President's Commission on Industrial Competitiveness that this year we will run a higher deficit in our trade account with Japan in electronics than we will in cars and trucks.

Coming from Michigan as I do, we have been very concerned about the cars and trucks portion, and still are. But I noted that the electronic portion now is going to exceed that, and I am concerned that if we don't continue to do what we have been doing here, we are likely to put ourselves at more of a national competitive disadvantage.

I was struck by the fact that you said that some international standards have now been adopted off the work that has been done here in the United States.

Did I hear you correctly on that?

Mr. HENRIQUES. That's correct, Senator. Much of the body of international standards in the area of computer and communications technology builds off of domestic work here.

Senator RIEGLE. It seems to me that that is a very important fact and something that we ought not let to slip away from us; that this ICST work is worth protecting, particularly when we talk about sunset/sunrise industries and future industries. It would certainly seem to me that in the area of the electronic technologies that those are things that we cannot step back from.

We have got to, I think, continue to lead in those areas, and it sounds to me as if that work is very important. And I take it, just to be sure that I heard you correctly, that your view was that the private sector would not necessarily be in a position to step in and pick this up.

Mr. HENRIQUES. That is correct. I think that while the competence may exist to do some of the research, I think the competitive factor among the various designs and various companies would serve to vitiate the effort. And I think appropriately, that we can and have worked with the Bureau very effectively and used them as an independent arbitor of the kind of design or competitive disputes that have come up. And their work has been a very settling force within the industry.

Senator RIEGLE. Just one other question on that. And that is, would you say that the rate of change and the dynamics in that area of technology late settling down or speeding up? How would you describe where we are at today, say, versus the last 5 years and looking ahead the next 2 or 3 years?

Mr. HENRIQUES. That is a very fortuitous question. We just did a study on that. The rate of change and the product cycle is shortening rather than lengthening. And where we might have looked at a 3- to 5-year cycle for a particular kind of product, computer product, now it is down to about 18 months.

Senator RIEGLE. And is there any reason to think that is going to stop? It sounds to me like the rate of change is accelerating.

Mr. HENRIQUES. I think it is accelerating and we hope if the Bureau could keep doing its work, not just in ICST, but also in the

ceramics and some of the other things that Dr. Ambler mentioned, we will be able to maintain that rate of change and therefore the relative technological lead that we have on the rest of the world market.

Senator RIEGLE. Have the three of you had the chance to read the report of President Reagan's Commission on Competitiveness?

Mr. HENRIQUES. Yes, sir; I have.

Senator RIEGLE. You have read it. And, Mr. Gerard, you have read it. But, Mr. Bush, you have not.

I think that it is probably the most important piece of work the Government has done in the last year or two because it takes a comprehensive view of things. These were all people appointed by President Reagan and therefore ones who would tend to be compatible with some of the things the administration wants to accomplish. But they, as you know in that report, strike a very alarming tone in terms of the slippage that we are incurring.

And it seems to me that in this area where we have been able to really maintain some leadership, although that is being challenged, particularly by the Japanese, that anything that would constitute a backward step would seem to come at the worst possible time.

Mr. HENRIQUES. I agree with you, Senator.

Senator RIEGLE. Would that be your view, too, Mr. Gerard?

Mr. GERARD. Yes, sir; that is correct.

Senator RIEGLE. Let me just ask you something while you have the microphone. I am told that more people per capita die in fires in the United States than in almost any other industrialized country. Is that correct?

Mr. GERARD. Yes, sir; that is correct.

Senator RIEGLE. What would the annual American death toll from fire be?

Mr. GERARD. The past year, for the first time in our history, it was under 6,000. But one of the reasons that the loss of life from fire has been coming down is the research that has been done at the Center for Fire Research.

Significantly also I think, it is fair to recognize that we burn up in this country every year about 6 billion dollars' worth of property. Wouldn't it be nice to have $6 billion in your hip pocket at the next budget hearing you go to?

Senator RIEGLE. Not to mention all the suffering and hardship. My family and I have been through a fire, so I know how horrifying that experience is.

Why is it that other nations, however, are able to somehow keep their per capita death rates below ours? What are they doing that we are not doing?

Mr. GERARD. I think there are several. There have been studies over the years. Why should the loss of life be different in one country than in another?

Part of it has to do with building construction. Many, many of our homes where most of the loss of life occurs are constructed of wood, where as in many of the European countries they long ago burned up all the wood and the buildings are built of stone and concrete.

Another is the attitude of the American people. We basically have a disposable society. And so saving things forever and ever

and ever, generation to generation, while that seems to be changing today, the attitude that property is disposable leads one to have less of a concern.

I know for 30 years I have gone to fires, and there are generally three questions that are asked at a fire. The first question that people ask: Was anyone hurt? If no one was hurt, the second question is: Was the property insured? If the answer to that is yes, then the third question is: Well, what are we going to talk about?

Senator RIEGLE. Well, you make a good point.

Let me ask you about the role that the Center for Fire Research played in the development of today's home smoke detectors, which seems to me to be a relatively new development that is spreading reasonably well. I want to know more about what our penetration rate is in terms of the number of people that have them.

Clearly, a smoke detector in a house is a relatively low-cost way to alert people when a fire might start, and hopefully save some lives.

What exactly did the Center do to make it possible to help get these detectors out into homes across the country, and where do we stand today on that?

Mr. GERARD. Well, prior to 1972, there were no standards, no test methods, no way of determining what was a good detector and what was not. And because there was not a test method and a standard, there was no acceptance.

Obviously, to have it accepted as a part of the law, you have to identify what it is you are going to accept. And so without that standard, there was no way for any requirements for installing detectors.

The National Bureau of Standards did research to identify how to evaluate, how to test a smoke detector, and spinning off from that industry very quickly identified ways of meeting that standard. And once the momentum began, recognizing the competition, industry put in millions of dollars of research on how to reduce the cost and reduce the cost, and so we went from—in the 1960's to put a smoke detector in your home would have cost several hundred dollars. Today you can to it for under $20.

And I think the basic activity of the Center for Fire Research is to turn the key. Once you turn the key, industry runs the engine and the competition brings the price down so that we can all benefit from that.

As far as saturation, most people accept that about two-thirds of the American homes today have smoke detectors.

Senator RIEGLE. Two-thirds?

Mr. GERARD. Yes, sir. There is a concern that people do not keep the batteries in them functioning, and so a lot of the follow-on activities today in fire departments are to test your detector monthly, make sure the batteries are working and that sort of thing.

But the saturation is very good. The most unprotected segment of the United States unfortunately is the poor and the elderly.

Senator RIEGLE. Probably in the houses most apt to burn in many cases.

Mr. GERARD. Yes, sir; that is correct. That is exactly right. And there are several programs that are being funded in the private

sector as well as the public sector to deal with encouraging local communities to provide detectors.

In Baltimore, for example, probably the closest example to Washington, they are raising money themselves in Baltimore with private subscriptions and so forth to put smoke detectors in the homes of the poor and the elderly.

Senator RIEGLE. Is there any work being done presently on home security systems which people are much interested in because of the incidence of crime and people not feeling secure in their homes?

Mr. GERARD. I think that there are some very good opportunities for using cable television, for example, for two-way communications both with a smoke detector and for building security, home security itself, to interact with a central station to in effect monitor your home on a 24-hour basis whether you are there or not for fire and intrusion.

Senator Riegle: Shouldn't the Bureau maybe be moving in that direction now?

Mr. GERARD. I believe a lot of the research they are doing in computers and electronic technology—I am really not familiar with that field, but I know in my heart of hearts that a lot of that technology transfers directly to interactive cable communication between your home and a central station that can monitor your home.

Senator RIEGLE. You know, Government often gets a bad rap, many times deservedly so; $600 toilet seats at the Pentagon are a little hard to defend.

But it seems to me that the work that has been done on fire detectors here and the fact that the development of standards has enabled the private sector then to bring the cost of these units down below $20, and that we now have a two-thirds penetration of protection in homes across the country, is a rather phenomenal accomplishment. The Government, it seems to me, has played a very constructive role.

So for those that might say there is no role for Government at all, it seems to me that this is quite a nice piece of work that has been done here. It obviously has taken that number of 6,000 deaths down from what otherwise would have been a higher figure. And I am sure that $6 billion of loss, I think you said, also would have been higher, had we not been able to get this cooperative piece of work done.

Mr. GERARD. That is correct. I think all of us look to our governments, local, State, Federal. We look to Government for leadership. And if there is anything that the Center for Fire Research has provided in this area, it is leadership. It is recognizing the direction we need to go. As we all said, leadership is not forcing people to go; it is leading the way.

And the Center for Fire Research does in fact lead the way in improved fire technology and building technology. You know, buildings are not safe by accident. They are safe because research has been done to make them safe and a lot of that research has been done by the National Bureau of Standards.

Senator RIEGLE. If I may very quickly, Mr. Bush, your testimony indicates that private industry is unlikely to perform the kinds of

work that is now conducted by the Center for Building Technology and the Center for Fire Research.

Why is this the case? And what kind of work do private construction laboratories perform? Explain to me a little bit why you feel the way you do.

Mr. BUSH. I gave the example of a testing device for thermal insulation which cost several hundred thousands of dollars to develop. And yet there are only about half a dozen customers for this device.

The private industry cannot make a profit and exist with such a small market and such a large research investment. And typically, that is the way it works with these measurement devices, expensive to develop, but very few customers for them. And that is the reason private industry would not do it.

Senator RIEGLE. And so just because it is financially not feasible for them to do it, the research that otherwise ought to go on would not go on? That is your view? And so you are saying is that this again is a residual function that if we want to have it done, requires a broad public effort, a common effort under the aegis of the Federal Government.

Mr. BUSH. This is a very proper and necessary function of government, I believe.

Senator RIEGLE. It sounds to me like it is cost effective by any measure of the economic benefits downstream; that you have to make a sensible, good-faith investment up front in the testing process. You will get all kinds of benefits, both in terms of private sector benefits and consumer benefits, down the line if we can find more sensible ways of doing things.

It seems to me that this is a very strong economic rationale, but it takes a public and private sector connection in order to really get the benefit.

Mr. BUSH. It just makes the greatest sense in the world, I think, to the most rightwing conservative individual, and I guess that is my category, but to have a standard pound, let's say. I mean this is what 16 ounces is, this is a pound. And everybody shall measure their produce or whatever wares they are selling on the basis of this. And that sort of standardizing function is something that somebody who is unbiased has to do.

And most of these testing devices are just that sort of thing; they are setting a standard; thus, the name of the Bureau.

Senator RIEGLE. Well, there are some people that are actually more conservative than you are, and their view takes them to the point that it is really the free market and the buyer beware, and that the government really has no role and ought to be withdrawn, and in the end everything will sort itself out. But I gather you are not prepared to go that far.

Mr. BUSH. Well, if private industry would. But in searching through construction research laboratory directors, I found that none of them held the opinion that if these functions were closed down that either a consensus process or a private industry would be able to pick up the gauntlet.

Senator RIEGLE. So there is a role for government there, a needed role?

Mr. BUSH. Yes, I think so.

Senator RIEGLE. Thank you. Senator Gorton, Senator Gore.

Senator GORE. Thank you, Mr. Chairman.

I would just like to briefly follow on to the questions that my colleague from Michigan has just asked you. I have long felt that the role of Government needs to change and evolve, and one of the more important areas that should receive more emphasis is the facilitating, coordinating role that allows the Government to provide information that enables private sector entities to move toward sensible goals. Both the Center for Building Technology and the Center for Fire Research really are sterling examples of government playing that role very, very well. And I support both of them. I think that it would be a serious mistake to allow these organizations to be eliminated.

Mr. Bush, you are here representing the National Institute of Building Sciences, is that right? And that is a private group authorized by the Congress, is that right? Tell me how that works.

Mr. BUSH. Well, it is a quasi-public/private entity. It was formed about—well, it was established by an act of Congress I think in 1974 with matching funding between private and public at that time, which was to end at the end of, I believe, 10 years.

Through the appropriations process the whole thing got kind of confused and messed up, but it is being funded by both the Federal Government and private interests or private resources at this time.

Senator GORE. But technically you are independent?

Mr. BUSH. Yes, independent.

Senator GORE. I was looking at the first statement you submitted to the committee, and I found it very interesting and valuable, and I want to compliment you on your testimony.

I was curious about one thing. You had an interesting paragraph here that seemed to have been eliminated from your final draft, and I want to read it.

> The Institute has been asked by the administration to study the programs within CBT and CFR and identify those activities that might be undertaken by a cooperative group of corporate interests. We are looking into this possibility with a view toward maximizing the use of NBS laboratory equipment and minimizing the loss of key Bureau staff. Another concern that bears on this study is the potential bias that may exist in test results or data generated by an industry group. One virtue of current Center for Building Technology and Center for Fire Research Operations is the objectivity with which they manage research and generate results.

Why was that eliminated from your final draft?

Mr. BUSH. This testimony, Senator Gore, is like a camel. It was created by a committee, and I think in the final go-through, either to make it more brief or for other reasons—I do not know. One thing that I did not mention, I am accompanied by senior vice president of the Institute, Brian Landergan. Perhaps he can answer that.

Brian.

Mr. LANDERGAN. No, sir, I do not have an answer, but we will get you one.

Senator GORE. Is it reviewed by anybody in Government?

Mr. BUSH. No, no, no.

Senator GORE. You do not have to go through OMB for any of this?

Mr. BUSH. No, no, no. We would be happy to, though. They are great editors.

Senator GORE. No, you will be happy just the way you are.

Mr. BUSH. We have Government members on all of our committees and boards, though, to balance things out.

Senator GORE. Well, let me take them one by one. The Center for Building Technology was the subject of some testimony last week at a hearing of this subcommittee on the Earthquake Reduction Act. It is only one of the many areas in which the Center for Building Technology is active.

Dr. Samuel Speck, the Associate Director for State and local programs at FEMA, told the subcommittee that FEMA relies heavily on the Center for Building Technology for expertise in the Federal earthquake program. He said that FEMA has nowhere near the expertise of CBT in this area, and that if it is eliminated, FEMA will likely have to contract out for the services now performed by the CBT.

In my view, this would cost as much and perhaps more than the current cost of CBT's program in this area, and I fail to see the logic in that proposal.

Another area that has been of interest to me is the area of structural failures. As chairman of a House subcommittee in the last Congress, I had some hearings on structural failures, and I got to know the Center for Building Technology people pretty well. They are the ones, for example, that investigated the collapse of the Hyatt Hotel in Kansas City, is that not right? They are the ones who go out and find the answers to these questions that architects and engineers around the country want to know in order to avoid repeating mistakes of that kind. That is correct, is it not?

Mr. BUSH. It is correct that they went out there. This is an area, however, of structural failures where there are very competent private laboratories to perform investigations, as I know you found in your hearings in the House.

Senator GORE. Well, we found that there is no central repository. That is another issue, and one which this subcommittee addressed last year, along with the House Science Subcommittee. Last year the House voted to put the authority in the CBT. And I am hopeful that will be done again this year.

I think that the Center for Building Technology has really performed its job well, and I hope that it can be saved. I would say the same thing about the Center for Fire Research, because it provides information and expertise to other agencies like the Consumer Products Safety Commission; it conducts its own investigations into fire safety issues. We have heard about the smoke detectors and what a success story that is, although there is much work to be done, particularly the effort underway on efforts to improve sprinkler systems and fire retardant upholstery.

I believe that the importance of the CFR becomes especially clear when you consider that without it, the United States would be the only major industrialized Nation without a central fire research effort. Yet we have the highest death rate from fire in the world.

Are we ostriches? Are we going to stick our heads in the sand? We have the highest death rate from fire in the world, and now we are proposing to become the only major country without any cen-

tralized research program into how to reduce this death rate. It is ridiculous. Maybe that is too strong a word, but actually I do not think it is. I will stand by it. I think that we ought to continue both of these agencies.

Thank you, Mr. Chairman.

Senator GORTON. Thank you, Senator Gore.

And thank you for your helpful and enlightening testimony.

Our second panel dealing with some of the new proposals in this administration budget will be Mr. Pete England of the National Conference of Standards Laboratories; Mr. Frederick Hume, John Fluke Manufacturing Co.; and Mr. Frank Samuel, of Health Industry Manufacturer's Association. If they will come forward.

Mr. England, we will start with you. And with the three of you, as with your three predecessors, your entire written statements will be included in the record as if read. We would ask you to try to limit your remarks to about 5 minutes.

STATEMENTS OF PETE ENGLAND, PRESIDENT, NATIONAL CONFERENCE OF STANDARDS LABORATORIES; FREDERICK HUME, VICE PRESIDENT OF TECHNOLOGY AND PLANNING, JOHN FLUKE MANUFACTURING CO., INC.; AND FRANK SAMUEL, PRESIDENT, HEALTH INDUSTRY MANUFACTURER'S ASSOCIATION

Mr. ENGLAND. Thank you.

Mr. Chairman, I want to thank you for your invitation to appear before your subcommittee today and address the NBS fiscal year 1986 budget item identified as process and quality control. I would like to briefly discuss two points this morning.

First, the U.S. national measurement system. What is it? It consists primarily of several thousand organizations, laboratories, and institutions all linked together, both voluntarily and by regulation, in an effort to ensure that their individual measurement requirements, as they perceive them to be, are in fact, "right."

We as an organization firmly believe that this U.S. national measurement system, this multilayered pyramid, if you will, with NBS at the apex of that pyramid, nurtures every element of American science and industry.

We also believe it is not only appropriate for the Bureau to set at the apex of this pyramid, but it is also essential. A pyramid, that to be effective, must not only be cohesive and coherent but also possess a high level of integrity. As an organization we think it is also the charge and the mission of the Bureau to monitor and provide a reasonable degree of stability to this system. And for such an essential and critical service, we—the Nation—provide it with only a small incremental portion of the total Federal budget.

My second point addresses our membership's express concern over the deterioration of the Bureau's capability to meet the needs of American industry—a trend that over the years has deprived the Bureau of the necessary funds to properly facilitize and staff its operation; a trend that has deprived the Bureau of adequate funds to perform critical measurement research and development; a trend in the Bureau's congressionally appropriated budgets that has remained essentially flat over the past 20 years in 1965 dol-

lars—all of this happening during a period of incredible advances in science, in technology and space. During a time when American industry has come to recognize not only the importance of implementing new process and quality control methods and techniques during manufacturing, but also, to recognize the equally important relationship that standards and accurate measurements has in that total quality scenario.

Yes, our membership is deeply concerned that as we permit this ongoing enfeebling of the Bureau that we also erode this U.S. national measurement system pyramid. And as this pyramid starts to come apart, the impact on quality and productivity, the impact upon science and technology, although recognized slow to mature, would inevitably be, in our opinion, a serious, if not crippling, blow to this country's leadership in high technology, to this country's health, to its safety and certainly to its security.

Yes, our membership has been deeply concerned for several years; so concerned that during the 1982 and 1983 timeframe we surveyed over 1,400 different companies and laboratory facilities, and we published a comprehensive document identifying 118 critical problem areas requiring NBS to develop either new or improved calibration services.

The NBS published response to that survey included 79 areas with planned new or improved services. However, the timeframes indicated by the Bureau are considered too lengthy in most cases to provide benefits to American industry's near-term needs.

Of the 118 requirements 39 are either not included in NBS plans or are so insufficiently addressed that no support to American industry can be expected.

Of course, we as an organization strongly support the $1.9 million budget issue before us today, but we also, with equal strength, deplore the failure to increase that request to $12.9 million, which would at least fully fund the original 1984 initiative, and in our opinion, meet the most critical of those core measurement requirements that American industry needs now.

To summarize briefly, we feel very strongly that the Bureau is a national asset, and what we do to it—or for it—today will have an impact on the health of that institution for years to come. A first small step toward full restoration of the Bureau's needed capability would be the approval of the initiative for process and quality control, approval—we recommend—without deleting funds from the other areas of that part of the NBS budget concerning basic standards.

A second step, one that would contribute to a reasonably short-term improvement in the NBS, would be to restore this initiative to the full amount originally proposed by the Bureau last year; that is, $12.9 million for fiscal year 1986.

Now, either of these two steps would slow the trend. However, it is the opinion of many within the NCSL organization, as well as others who work in the measurement science field, that indeed a much larger step is warranted. It is our conclusion that the condition of the Bureau in regards to measurement services is critical enough to justify a call for a special congressional hearing to address both the current as the well as the projected future needs of this Nation.

I thank you, Mr. Chairman, and that basically concludes my in-person testimony.

[The statement follows:]

STATEMENT OF THE NATIONAL CONFERENCE OF STANDARDS LABORATORIES

Mr. Chairman, on behalf of the industrial members of the National Conference of Standards Laboratories, I want to thank you for your invitation to us to testify concerning the NBS budget proposal for FY86. We were privileged to attend these hearings last year and to submit written testimony relative to the FY85 NBS budget.

My name is Pete England; I am the President of the NCSL. This statement, which was contributed to by Bryan Werner (our Executive Vice President), George Rice (our current immediate Past President), and Hartwell Keith (Chairman of our Government Relations Committee and former President), will address three points: (1) The U.S. National Measurement System and the role of the NBS in that system, (2) Our membership's concern about the perceived trend in deterioration of NBS' capability, and (3) Some likely outcomes if that deterioration is allowed to continue.

First, though, permit me to give a brief overview of the NCSL organization. The NCSL is a laboratory management oriented organization of some 700 metrology and calibration laboratories, over 600 of which are domestic (U.S.) members. Our purpose is to foster cooperative communication in the solution of the common problems of these types of laboratories. As an "organization of organizations," our members include laboratories in manufacturing industries (aerospace, electronics, biomedical, energy, automotive, etc.), in government (state weights and measures, DoD, NASA, etc.), in educational institutions and others having an interest in measurement science. In our role here we are representing the almost 600 laboratories which are neither in government nor from a foreign country.

THE U.S. NATIONAL MEASUREMENT SYSTEM

There is probably no more important system in the U.S. today which is as little understood as the U.S. National Measurement System; there is probably no other institution with such a vital role in that system than the NBS or whose contributions to the American economy and the well being of the American people are so poorly perceived. What is this "U.S. National Measurement System?" First, it is information. That is, it is not a legislated or mandated organizational hierarchy. Although there are some aspects within the system that are regulated in one way or another, it is predominately voluntary. Within the total system are tens of thousands of laboratories, institutions, and organizations linked together in an effort to ensure that their individual measurement requirements—as they separately or in concert with others determine them to be—are "right." This determination is accomplished through a process of comparison of standards, instruments and artifacts with standards of higher accuracy in a continuous way to some ultimate standard. In the U.S., this "ultimate standard" resides at the National Bureau of Standards.

This informal U.S. National Measurement System, then, can be visualized as a multi-layered pyramid. At the bottom are the measurements made in commerce or industry on its products. Near the middle are the standardizing laboratories which calibrate (i.e., compare the accuracy of) the instruments used in the lower layers. At the top—the apex of the pyramid—sets the NBS which maintains the national measurement references for the U.S. and which disseminates these references to the lower tiers normally through calibration of the standardizing laboratories' standards.

As can be appreciated, this U.S. National Measurement System is an integral part of every element of the American economy—science, industry, commerce and trade and provides for:

Equity in trade and commerce (here and abroad);
Progress in science and technology;
Product quality and industrial productivity;
Universality or equivalency in engineering and production methods;
Health and safety of all Americans;
Health of the American economy together with the security of the Nation.

We believe that it is not only appropriate that the NBS is at the apex of this "U.S. National Measurement System pyramid," it is essential. Such a system must be both cohesive and coherent and have a high level of integrity; we think it is the charge of the Bureau to provide stability to this system through its primary mission of maintaining and disseminating the nation's standards of measurement to the public as first stated in the NBS Organic Act of 1901.

The U.S. National Measurement system and the National Bureau of Standards are both almost invisible to the public; yet, the importance of these—and particularly the NBS—is inestimable. And for the National Bureau of Standards to carry out this essential service, we—the Nation—provide it with only a very small fraction of total Federal funds.

NCSL MEMBERSHIP CONCERNS

Our membership's concerns are concentrated in a perceived deterioration of the primary mission of the NBS: maintenance and dissemination of the nation's measurement references. As you know, deterioration in such services (even though it may be pervasive in the economy) is slow to be seen. Just as it takes time to build and nurture a system such as this, it takes time for voids or discontinuities to have their effect in manufacturing or commerce.

Because of that concern, which started to surface in the late 1970's, the NCSL organization, through a standing committee (National Measurement Requirements Committee), undertook an extensive survey and study of our membership and those others we could identify within the measurement community. The results of this comprehensive study were compiled and published in 1983 and presented to the NBS for response and also to assist them in establishing internal priorities in its measurement service work.

At about the same time, but independently, the Bureau had developed its own evaluation of the Nation's measurement requirements. This proposal was reviewed by a "blue-ribbon" task team from both industry and government and resulted in an initiative in the amount of $13.5M.

Our written remarks to this Subcommittee last year deplored the failure of the Administration to request that full amount of $13.5M needed to restore these immediate and essential services to an acceptable level. We, of course, strongly supported the reduced request of $2.5M, of which only $560,000 was eventually appropriated by Congress. Two independent evaluations, identifying (20) different positions of current core measurement requirements, resulting in a proposed initiative priced at $13.5M was whittled to $560,000. We were shocked. We were dismayed.

The proposed budget item before us today includes an increase in the amount of $1.94M for an NBS FY86 item identified as PROCESS AND QUALITY CONTROL. The need for U.S. industry to improve product quality and reliability is almost universally recognized. In order to assure this required improvement in quality and reliability: continuous assessments must be made on the product; processes must be monitored; inspections must be made; conformance to specifications, documentation and drawings must be verified; and, examinations and analyses must be performed.

At the foundation of all these activities are measurements. Those of us who work in the measurement science field firmly believe that as U.S. industry strives to improve its implementation of newly developed quality control processes and methods, it is absolutely counter-productive to allow (or permit) the foundation for those methods to be eroded.

In regard to the proposed budget item, of course we strongly support this initiative. But, we also (with equal strength), deplore the failure to increase the request to $12.9M which would fully fund the original initiative and, in our opinion, meet the current critical core measurement requirements essential to the well being of the National Measurement System.

In just one area (RF and microwave), concern for the lack of NBS capability is so great that it has lead to the formation of an ad hoc committee within the IEEE. The NCSL has joined this effort and is cooperating with the IEEE Committee to focus attention on this vital area. This committee to Promote National Microwave Standards (PNMS) has identified a number of deficiencies in the NBS which, although having a significant impact in the defense and intelligence sectors, are of increasing importance in the non-defense sector as well. We cite this example not just to mention the importance of this one sector, but rather to bring to your attention that this one sector is but the tip—a highly visible tip, to be sure, but nonetheless just the tip—of an iceberg that looms beneath the surface. This Nation cannot afford to let other measurement areas within the Bureau's mission deteriorate to such a level as to require the formation of additional private sector initiated "Committees to Promote National Standards." All deterioration must be halted; new and improved services must be developed and provided; the U.S. National Bureau of Standards must once again be allowed to reach its proper place as the world's pre-eminent laboratory for standards and standards dissemination.

PROJECTED IMPACT AND CONSEQUENCES

What's going to happen if we continue this trend of depriving the Bureau of the funds required to properly facilitize and staff its operation or to perform critical research and development in measurement phenomena?

First, I suppose, is the potential for additional committees to Promote National Standards—extremely costly and delayed "get well" programs. As noted previously, the one area of microwave and millimeter wave technology has forced the creation of a high level committee to Promote National Microwave Standards. Others have already identified that national standards needs in this one area alone as requiring NBS funding of $5 to $6 million per year for the next five years. It would be devastating if this were to happen in other measurement areas.

A second result would be for the users of NBS services to seek elsewhere for alternatives; some have already begun having their standards work performed by the NRC in Canada. An attempt would probably be made to develop makeshift in-house methods or to develop small industry consensus arrangements. These methods, however, are extremely costly when considered in totality—the myriad of small and localized standards setting arrangements would in the long run lead to chaos in industry and commerce.

Finally, some would throw up their hands and just do nothing. The impact upon quality and productivity, although slow to mature, would be, inevitably, a serious if not crippling blow to this Nation's attempt to compete in the world market place.

None of these approaches is viable in the long run; most are counter productive almost from the start. All are certain to lead to a major crisis, one that is recognized by all, and one that the typical solution for which (based on practices in both government and industry) is solved only through expenditures of vast sums of money. The costs resulting from the confusion and waste that will ultimately accompany the need to eliminate the crisis will be significantly larger than the total annual budget of the NBS.

SUMMARY

Implicit in the concept of the U.S. National Measurement System is the fact that precision measurements are basic to every area of science, every area of research, every area of technology and to most areas of modern manufacturing. We, who work in the measurement science field, believe that scientific and technical progress must always be preceded by advances in our ability to measure. Thus, without a continuing research and development effort at the national level into all aspects of measurement phenomena, without an effective and practical means for delivering the results of that research to the public, without a strong and effective U.S. National Measurement System guided by the NBS, without all of these, our leadership in high technology, the Nation's health, economy and certainly its security, will be in jeopardy.

An examination of the budget provided to the NBS since 1965 discloses that it (the budget) has been essentially flat over that period in constant 1965 dollars. During a period of two decades, which have seen incredible advances in science, technology, and manufacturing, the Nation's citadel of standards has had budgets destined to ensure that it would be unable to meet the measurement needs of American industry, commerce and defense. We feel very strongly that the Bureau is a national asset; what is done to (or for) the NBS today will determine the health of that institution for years to come. We owe it to our future not to let its capability deteriorate further. And when I say "we," I mean those of us who work within the measurement science field and those of you who must make the difficult decisions on national priorities and their respective funding requirements. We, together, owe it to the future of this Nation to halt this trend. Now is the time to stop this continuous enfeebling of the Bureau and the attendant erosion of the U.S. National Measurement System. I, for one, believe that this trend in America today need not necessarily be our destiny. A first—albeit small—step in the long walk necessary to restore the bureau to robustness is the approval of the initiative for PROCESS AND QUALITY CONTROL—approval without deleting funds from the other areas of that part of the NBS budget concerning basis standards. A second step—one that would contribute to a reasonable short term improvement in the NBS—would be to restore this initiative to the full amount orginally proposed by the Bureau last year ($12.9M for FY86). Either of these steps would slow the trend. However, it is the opinion of the National Conference of Standards Laboratories and others working in the measurement science field, that a much larger step is warranted. We believe that the measurement services' condition at the NBS is critical enough to justify a

call for a special congressional authorization to fully meet both the current as well as the projected future needs of this Nation.

Mr. Chairman, I thank you for granting me the opportunity to speak before your subcommittee today. That concludes my remarks, unless you have some questions that I might be able to respond to today.

Senator GORTON. Thank you.

Mr. Hume, welcome.

Mr. HUME. Thank you very much, Mr. Chairman, and honorable members of this Senate committee.

I am vice president of the John Fluke Manufacturing Co., located in Everett, WA. We are a manufacturer of electronic instrumentation. We have an annual sales revenue of $240 million, and we employ 2,800 people. I am also chairman of the Washington Council of the American Electronics Association, and a member of its national board of directors. And I would like to thank you for the opportunity to talk about the vital relationship between the National Bureau of Standards and the competitiveness of our technology and our manufacturing capability in the United States.

The American Electronics Association recently compiled some figures which were derived from Department of Commerce statistics that showed the effect of the trade deficit in the last year with regard to Japan and Western European countries. And in 1984 for the first time we showed a trade deficit approaching nearly $7 billion in all of the electronic industries combined, principally because of a trade deficit with Japan.

While there are many factors that affect the competitiveness of our industry, and the strong dollar is certainly one of those elements, it is clear to us that there is a strong relationship between the capability of the National Bureau of Standards and the international competitiveness of our industry.

If you go back a few years ago, about 20 years ago Dr. Edwards Demming did a tremendous job in educating Japanese industry on how they could apply statistical quality control concepts to make their industry competitive.

At the heart of those statistical quality control measures is the ability to make measurements in an industrial environment, and the NBS plays a key role in providing the kinds of measurement standards that are necessary for industry to be able to make the kinds of measurements that keep its process and statistical control.

I believe we are living in a time, a new era, an era where industry and government have to collaborate to make sure that an industry can be competitive. When I was a research engineer with Rockwell 20 years ago, NBS was supreme among all of government agencies around the world in maintaining standards and providing those standards to industry. Over the last 20 years I have seen that supremacy decline so that even at this point in time, the People's Republic of China is providing capabilities and measurement services to their industry that are not provided by the National Bureau of Standards in the electronics area; for example, the dissipation factor of capacitors.

I applaud the National Bureau of Standards' efforts a few years ago with their MAPS programs, Measurement Assurance Programs, to take standards out into industry. We recognize that you just cannot tear apart your manufacturing systems and send the

pieces off for calibration. You have to disseminiate those standards out into industry. You have to do it in place.

The MAPS Program was a good first step. The NBS process and quality control initiative was a good, small but important second step. And I urge you to support the requested funding of $2½ million in the 1986 budget.

Thank you.

[The statement follows:]

STATEMENT OF FRED HUME, VICE PRESIDENT, TECHNOLOGY AND PLANNING, JOHN FLUKE, MANUFACTURING CO., INC.

Mr. Chairman and honorable members of this Senate Subcommittee, thank you for inviting me to testify before you today. I am Fred Hume, Vice President, Technology and Planning of the John Fluke Mfg. Co., Inc. I am here to testify on the increasingly important role of the National Bureau of Standards to U.S. technology and manufacturing competitiveness.

For those of you unfamiliar with our company, it is headquartered in Everett, Washington, and has sales offices and manufacturing facilities all over the world. We are a leading manufacturer of test and measuring instrumentation, have annual sales revenues of over $200 million, and employ some 2700 people. The continued annual increase of those statistics will depend on how well we compete in both U.S. and international markets.

The American Electronics Association, of which I am a director, recently published statistics which show a rapid decline in the trade balance of our industry over the last four years. While the industry enjoyed a significant trade surplus in the years prior to 1984, the balance of trade turned negative by $7B in 1984, due to increasing competition from Japan. At our own firm, exports have declined from a high of 39% of Sales a few years ago, to 34% in 1984.

U.S. industry is rapidly losing its competitiveness as other countries assimilate our technology and adopt manufacturing process controls such as those practiced so effectively in Japan. Process Control has been proven to be the key to Quality and Productivity over and over again. The fundamental basis for process control is measurement in general (or Metrology) and measurement in-situ (the operating environment) specifically. This is the method of statistical quality and process control which was taught by W. Edwards Deming to the Japanese government and industry after the war, and applied so successfully by them. NBS has many of the tools necessary to help industry apply these quality and productivity methods. Unfortunately, their priorities have been focused on other needs.

Over the first sixty or seventy years of its existence since its creation in 1901, the National Bureau of Standards (NBS) did an outstanding job of developing and maintaining physical and electrical standards to support industry's growth and development. Unfortunately, the NBS role was too often like that of an impartial bystander, rather than that of a partner with industry. This was manifest in Calibration Certificates, provided by NBS on industrial equipment, which were only valid in the NBS environment and of little value to the ultimate user who was to apply the equipment in a manufacturing environment. This led to the increasing irrelevance of NBS, and resulted in criticism and lack of support by industry, and neglect by the Federal Government.

The preeminence of the NBS among international standards organizations has also declined. Other nations have aggressively pursued new measurement services to support their industry, while the NBS has been directed to apply its resources in other areas. That decline foreshadowed the decline of U.S. technological superiority, which is a painful reality today.

Certain measurement services are not provided by the NBS, and American companies must send their equipment outside the U.S. to be certified. One noteworthy example is a capacitor dissipation measurement, a service which the NBS does not provide, but England, Germany, and the People's Republic of China do! My company is selling instruments in kit form to the PROC to be assembled and calibrated there per our standards. They are still learning basic manufacturing techniques, and yet they can already provide advanced measurements that we can't. The NBS is simply not able to offer the services American industry needs.

During the past ten years, or so, the NBS has begun to recognize the need to increase the relevance of its services by implementing Measurement Assurance Programs (MAPS) which make calibrations meaningful, because they are performed in

the user's environment. The NBS proposed Process and Quality Control initiative is another step in the right direction.

The request that the FY86 budget for their Process and Quality Control programs be restored to the full $2.5 million, requested by the Administration in its fiscal year 1985 Congressional submission, would entail an increase of $1,944,000 over the amount appropriated last year by Congress—$556,000. This would provide sufficient funding for five sorely needed new measurement services in areas which have been identified by national organizations and endorsed by a panel of industrial and government experts.

NBS must focus on its role in supporting the growth and development of American industry. When coupled with adequate Federal funding, this focus can help our industry regain its leadership position in world markets.

Thank you for your time and support for this request.

Senator GORTON. Thank you very much, Mr. Hume.

Mr. Samuel.

Mr. SAMUEL. Thank you, Mr. Chairman.

I am here representing the Health Industry Manufacturers Association, whose members include companies that make all kinds of medical equipment, sophisticated imaging devices, medical supplies and so forth. We represent only one segment of biotechnology development, but it is the one that has so far yielded the most commercialized products, basically in the area of medical diagnostics.

Just to give you one example of the promise which we think biotechnology holds for our particular sector of health care, the existing test for determining the presence of meningitis, which is a fairly serious disease, takes 36 to 72 hours. In other words, from the onset of a suspicion that there may be a problem, it takes 2 or 3 days with existing technology to figure out whether in fact your child does have meningitis. A new monocolonal antibody test now on the market reduces that time to 10 minutes. So the opportunity for improved therapeutic intervention is greatly enhanced.

The important thing that I want to leave with you this morning is that the $3 million research program which we are recommending that NBS be authorized to pursue would, however, be applicable to all areas of biotechnology, not just the medical area. It would be applicable in agriculture, chemicals, metallurgy, and biomass conversion, as well as in health care.

It is clear that biotechnology as an overall industry is in its very early stages. It results from an immense amount of NIH research. It results from a $1 billion private sector investment in 1983 alone in developing commercializable products. And what we are proposing this morning is that NBS be given a modest program to build on its traditional strengths in ways that would be broadly applicable to measurement standards and scientists in all areas of biotechnology.

I think it is a fair question for the committee to ask: why does not the private sector do this? I think the best answer to that question is that when you are dealing with measurement standards, you need a credible body to develop those standards. No individual company would have the credibility or the acceptance, either domestically or internationally, if it were to invest the money in developing those measurement criteria.

Second, many of the companies in the biotechnology field are very small. There is a great deal of ferment by a large number of the companies, over 200 of them. All of them are individually quite

small. None of them themselves have the capacity to develop this kind of work.

Third, we have at NBS a central repository for a good deal of scientific expertise in physics and chemistry which would be directly applicable to this area.

Last, I want to just make a comment that has been touched on before about international competitiveness. The medical device and diagnostic segment of our economy is one of the relatively few manufacturing segments which has at least heretofore resulted in a net trade surplus, in 1983 roughly $1 billion.

In 1983, we ran a modest surplus with respect to Japan to the tune of some $84 million. We understand that in 1984 we have slipped into a trade deficit with Japan to the tune of $100 million—very small in relation to the order of magnitudes that have been discussed earlier today—but the trend is very disquieting, particularly at a time when Japan has made an extraordinarly intense commitment to research and development in the biotechnology area.

So we think that a $3 million authorization for the National Bureau of Standards in this area is a rather modest supplement to the NIH research and to the private investment that has been already made. It would probably be matched by in-kind contributions and time spent in working with NBS scientists by private industry, and would yield benefits for all sectors of our economy in the near and long term.

Thank you, sir.

[The statement follows:]

STATEMENT OF FRANK E. SAMUEL JR., PRESIDENT, HEALTH INDUSTRY MANUFACTURERS ASSOCIATION

Mr. Chairman and members of the subcommittee, good morning. My name is Frank Samuel and I am the president of the Health Industry Manufacturers Association (HIMA). HIMA is the national trade association representing over 300 manufacturers of medical devices and diagnostic products. It is my pleasure to appear before you this morning to speak in support of the new biotechnology initiative by the National Bureau of Standards. As you consider reauthorization legislation for the National Bureau of Standards, I would urge you to include new funding for biotechnology—specifically, measurement standards and services research.

INTRODUCTION

Biotechnology, as you know, has applications in many industries: agriculture, both plant and livestock, chemicals, toxic waste degradation, and extraction of metals from ore, to name a few. My job this morning, however, will be to concentrate on yet another way biotechnology impacts on our lives quite directly—the uses of biotechnology in medicine and health care. More particularly, I will present the key reasons why the National Bureau of Standards should be funded to develop a national research program for measurement standards and services for biotechnology.

KEY POINTS

The key points that I want to leave you with today are as follows:

Biotechnology—and American companies who manufacture products applying biotechnology in health care—have the potential to dramatically improve the way we diagnose and treat disease.

A significant gap in the research continuum now exists in the United States and may affect further development of biotechnology.

Because many other nations subsidize process development and measurement standards research at higher levels than in the United States, America's continued leadership in this field may be at risk.

The proposed funding to the National Bureau of Standards could be a constructive step towards facilitating further biotechnology through efficient cooperation among government, academia and industry.

CHARACTERISTICS OF MEDICAL DEVICE AND DIAGNOSTICS INDUSTRY AND BIOTECHNOLOGY COMPANIES

Let me begin by describing several characteristics of our industry and its role in the economy in order to highlight why biotechnology research is especially important now:

HIMA and the industry

HIMA's membership accounts for more than 90 percent of domestically manufactured devices and diagnostics and makes virtually every type of device and diagnostic product on the market today. Yet most of our members are small. Two-thirds have annual sales of less than $10 million.

Developing medical products requires research investments--investments our industry makes at a rate three times the national average. Nearly half of the respondents in a survey done for the Food and Drug Administration indicated their company had introduced a significant innovation in the last 10 years.[1] Research of this kind produces health care products that, in turn, produce longer, healthier lives for all of us.

The industry's contributions extend beyond health care. Small companies create most new jobs in the economy, and this is pronounced in our industry.[2]

Our industry is one of the few in the manufacturing sector that generates a foreign trade surplus. The U.S. exports twice as many devices and diagnostic products as it imports. This highly favorable balance of trade yields 15,000 jobs directly and many more thousands indirectly.

HIMA represents a substantial number of manufacturers whose products apply biotechnology to health care. Our companies apply biotechnology to diagnostic uses. Other companies, of course, are actively investigating therapeutic application of biotechnology. Both sorts of products with medical uses are regulated by the FDA.

Biotechnology

Biotechnology is a young industry. The first gene was cloned in 1973 and most new biotechnology firms have been founded since 1976. Of the 220 companies now involved in commercial biotechnology, 129 companies have started up in the last 12 years. HIMA has seen the recent emergence of biotechnology activity by both new companies and established companies diversifying into biotechnology activities.

Biotechnology is a field with tremendous economic potential. The biotechnology industry can stimulate the American economy through the growth of new business activity. There is a potential worldwide market for all biotechnology products—not just health care related—estimated at between $9 billion to over $50 billion by the year 2000.[3]

A telling fact is the over $1 billion that the U.S. private sector has invested during 1983 to commercialize biotechnology.[4] What this says in clear language is that American business is strongly committed to developing biotechnology.

HIMA is especially concerned since the biomedical applications of biotechnology will have a significant impact in health care in the next 5 years whereas the impact on other industries may not be seen for 10 to 20 years.[5]

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[1] "A Survey of Medical Device Manufacturers," Louis Harris and Associates, July 1982.

[2] Between 1980 and 1982, small business generated the 984,000 net new jobs in the United States (the 2.6 million new jobs more than offsetting the 1.7 million slots lost by larger firms). "The State of Small Business: Report of the President," 1984, p. 25. And, according to a survey by Dun & Bradstreet, small companies accounted for more than half the 3 million new employees hired in 1984.

[3] A National Program of Measurement Services and Standards for Biotechnology at the National Bureau of Standards, William H. Kirchoff, March 1985, NBS Planning Report No. 22, p. 1.

[4] Commercial Biotechnology, An International Analysis, (Washington, D.C. U.S. Congress, Office of Technology Assessment OTA-BNS-218, January 1984), p. 3.

[5] Ralph W. F. Hardy and David J. Glass "Genetic Engineering"—"Our Investment What's at Stake?" Issues in Science and Technology, Vol. I, No. 3, National Academy of Science, National Academy of Engineering, Institute of Medicine, p. 76. (Significant impacts—new products, and, improved products.)

USES OF BIOTECHNOLOGY IN HEALTH CARE IMPROVING DIAGNOSIS AND TREATMENT OF DISEASES

One of the best known uses of biotechnology in the health care industry is the creation of monoclonal antibodies to diagnose and treat disease. For example, monoclonal antibodies can identify hepatitis B and other viral infections, bacterial infections such as streptococcus, venereal diseases, and even cancer. Monoclonal antibodies perform these diagnostic functions through *in vitro* tests—that is diagnostic products which operate in a glass, or test tube environment outside the body. In contrast, there are also monoclonal antibodies which work inside the body, know as *in vivo* diagnostic products. Some such *in vivo* products help diagnose heart attacks,[6] others can localize cancerous growth.

In addition to diagnostic functions, monoclonal antibodies serve preventive and therapeutic purposes such as passive vaccines for herpes or hepatitis B.

The striking features of monoclonal antibodies are their increased sensitivity, quicker results, and, in some cases, lower prices than conventional diagnostic tools.[7]

Biotechnology in health care includes not only the development of monoclonal antibodies but also many other products such as antibiotics, vaccines for influenza and polio, blood products, interferon to treat cancer, and human insulin.

To give you some idea of the companies involved in this exciting area, let me note a few of the companies with active biotechnology programs—Abbott Laboratories, Eli Lilly, Travenol-Genetech Diagnostics, Cetus Corporation, and Miles Laboratories. Another HIMA member developing monoclonal antibody products is Genetic Systems Corporation in Seattle, Washington. Altogether, some 45 of HIMA members have interest in biotechnology.

The need for measurement services and standards research

These and many other companies have dynamic research programs. But there is one part of a total research effort which is lacking—that is research into the measurement standards, services and process development. This research in its broadest context has been referred to as generic applied research. Generic applied research is not product specific, but creates techniques, standards and products which can be used across the biotechnology industry.

Measurement research in critical to establishing a solid, continuous, and comprehensive research base. The National Bureau of Standards biotechnology initiative would beging to fill the gap and enhance long-term commercialization of biotechnology by American companies.

What will this research produce in the context of biotechnology and medicine?

(1) Measurement methods will be a substantial part of the research effort, encompassing physical, chemical, and engineering techniques and mathematical models. The purposes of these measurement methods range from checking the design of a manufacturing process or the validity of a production technique, to analyzing the purity of a finished product.

(2) Standard reference materials will be produced which can resolve differences among different production methods.

(3) Reference data on thermophysicial properties of fluids and gases will be generated which is important for the design of production scale bioprocesses.

One analogy of how generic applied research works is the atomic clock which sets an absolute standard against which the operation of other clocks can be compared and the accuracy verified. Likewise, the NBS biotechnology initiative will produce measurement standards to facilitate the manufacturing process.

THE CHALLENGES: HAPHAZARD PROGRESS AND INTERNATIONAL COMPETITION

There are deficiencies in funding for measurement related research which pose two challenges to the development and commercialization of biotechnology. One, without fundamental measurement techniques and standards, the progress of biotechnology could be haphazard and slow. Two, the international competition in this area threatens American business' continued leadership in the race with other countries whose governments more actively support measurement related research. The United States ranks behind Japan, Germany, the United Kingdom, and Switzerland in its relative commitment to measurement related research as opposed to basic research.[8] Generic applied research received $6.4 million in U.S. federal funds

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[6] Commercial Biotechnology, An International Analysis. (Washington, D.C. U.S. Congress, Office of Technology Assessment OTA-BNS-218, January 1984), p. 147.

[7] Becton Dickinson's monoclonal antibody test kit for detecting meningitis—10 minutes—$2 per test. Commercial Biotechnology, p. 145.

[8] Commercial Biotechnology, p. 324.

as contrasted with higher funding levels in Japan, Germany, the United Kingdom and Switzerland. Notably, Japan has targeted biotechnology as an industry for governmental support and promotion.

The Office of Technology Assessment Report: Commercial Biotechnology: An International Analysis made several salient observations of the international challenge which I would like to quote:

"The current pattern of U.S. Government funding for basic and generic applied research in biotechnology in the United States may compromise the U.S. competitive position in the commercialization of biotechnology . . . . Because the U.S. government has provided comparatively little funding for generic applied research, however, Americans may not be as efficient as the Japanese in applying the scientific base to the development of marketable goods and services.

The Japanese Government's funding for generic applied research allows companies in Japan to make optimum use of the basic scientific knowledge of the United States and other countries and very efficiently develop this knowledge into marketable products.

U.S. industry draws on the basic science knowledge base also, but the speed of the diffusion and development of this knowledge may be slower and ultimately more costly than it would be if more generic applied research were funded by the U.S. government.

Federal support could ensure more rapid diffusion of generic applied knowledge thus enhancing U.S. competitiveness in biotechnology.[9]

NBS—academia—industry: a cooperative and coordinated approach

The lack of organized measurement related research can best be addressed by the coordinated efforts of NBS working together with academia and industry.

There are a number of reasons why funding the National Bureau of Standards is the best course of action. NBS has the scientific and technical capability to develop biotechnology measurement procedures. One component of this capability is NBS's well integrated contacts with academia and industry. These contacts are vital to acquire data and then disseminate the results of generic applied research throughout the industy. The National Bureau of Standards' research products will be available in all parts of the United States and diffusion of the knowledge can proceed rapidly from NBS. This is especially true since NBS processes and data have credibility for broad application that no one company or university would have. In addition, NBS is the designated federal agency to establish measurement standards.

Two final and general points on why this is an appropriate route. Such funding will contribute to America's positive balance of trade in the medical device manufacturing sector. Lastly, this funding is a fine example of "Good bang for the buck," meaning that the little the federal government puts in will go a long way for American business and the American people. The proposed $3 million authorization should facilitate American commercialization of biotechnology.

CONCLUSION

In conclusion, I would like to say that medical applications of biotechnology have tremendous potential for improving the quality of life for American citizens. These benefits can be realized with the coordinated support of the American business and academic community. Funding the biotechnology initiative for measurement standards and services through the National Bureau of Standards will give American biotechnology manufacturers a better opportunity to compete in a challenging international race to commercialize biotechnology. I stand here today to demonstrate our desire and commitment to participate in an united effort.

Therefore, on behalf of the Health Industry Manufacturing Association and the many enterprises which could be affected, I urge you to include funding for NBS for the new biotechnology initiative.

[The following information was subsequently received for the record:]

QUESTIONS OF SENATOR GORTON AND THE ANSWERS THERETO

Questions. Most of the program objectives in section IV of the Bureau's report, "A National Program of Measurement Services and Standards for Biotechnology," seem to be basic research topics; the National Science Foundation (NSF) currently funds

[9] Commercial Biotechnology, pp. 323-324.

these types of projects. For example, programs at the National Science Foundation, the National Institute of Health, and in industry are studying protein structure and function.

Is the Bureau the proper place for this type of basic research?

Answer. Yes, the Bureau is the proper place for the proposed type of basic research. This is because NBS will direct its protein studies to both clinically and industrially significant measurement standards and services. Many university programs concentrate on issues with principally clinical significance.

Moreover, NBS has special expertise in methods for studying protein structure and function. NBS' instrumentation and trained personnel have the capability of studying protein issues in ways qualitatively different than the average laboratory funded by the National Science Foundation, the National Institute of Health or industry.

NBS has a unique combination of research tools including: x-ray and neutron diffraction; nuclear magnetic resonance spectroscopy; computer modeling capabilities with quantum mechanics (experts) and a class 6 computer ($8 million); micro calorimetry; high performance liquid chromatography.

This combination of high technology research instruments and experienced staff can study proteins in an integrated program not generally available in other research institutions.

Questions. A number of laboratories across the country are working on each of the program objectives mentioned in section IV of the Bureau's proposal. Will the Bureau's biotechnology program duplicate these research projects which are already being funded, for the most part, by NSF and industry?

Answer. We are not aware of duplication between the NBS biotechnology program and those research projects which are already funded by NSF and industry. As described above, there will not be duplication by virute of the special research approaches possible in NBS research labs and NBS' unique focus on measurement.

In contrast, academic research often does not examine measurement standards in as great detail as NBS proposes to do. Also, academic studies are not as broadly applicable as the protocols NBS intends to pursue. Likewise, industry research is product specific, unlike NBS studies whose results will benefit all segments of the public.

Lastly, NBS intends to coordinate its research efforts with other federal, university and industry projects to minimize potential duplication.

Question. Many companies have biotechnology research programs. For example, Genetic Systems Corp. is developing monoclonal antibody products. What are the measurement problems that such companies are unable to solve? Why are these measurements difficult to achieve? What standard reference materials are required by the biotechnology industry?

Are these services required by the biotechnology industry now or in the near future?

Answer. Companies are unable to develop uniform, national measurement technologies for use in developing and producing biotechnology products, especially as to testing uniformity and purity.

Industry can address industrial needs on an *ad hoc* basis but such methods are inadequate for rapid commercialization of biotechnology, which will require accurate and well-defined measurement systems for general industrial use.

Measurement techniques are difficult for industry to develop because industry lacks the unique combination of technical equipment and personnel which NBS has. Further, it is the logical function of NBS as the national repository of equipment and personnel to take the leadership role in coordinating the development of measurement technology for biotechnology.

NBS work on standard reference materials (SRMs) exemplifies the type of project which is most properly done by NBS. SRMs are pure, well characterized chemical or biological materials that define the compound in question. Just as NBS maintains the basic units of mass and length, it also maintains pure chemical preparations which are used by the scientific and industrial communities as a basis for all measurement of the material. It is inappropriate for manufacturers to develop their own SRM's as it would be for them to define their own yard stick.

NBS will develop SRMs that will ensure proper calibration and measurement of electrophoresis procedures. Electrophoresis is a basic laboratory procedure used to separate various chemical compounds such as the proteins produced by biotechnology companies. Improved measurement capabilities that result from the use of SRMs should help manufacturers prepare purer protein preparations. The SRMs will improve electrophoresis capabilities which will in turn lead to better, purer biotechnology products.

NBS also has an active and well received program developing standard reference materials for the clinical laboratory.

The measurement services could be effectively used by industry now.

Question. Section IV of the Bureau's proposal lists numerous (19) "near-term measurement objectives." Is the Bureau being realistic in its expectations of studying this large number or projects, or should the Bureau attempt to be more focused?

Answer. NBS has correctly identified important near-term measurement objectives. Whether they can all be accomplished turns on funding and research cooperation. Depending on them, a narrower focus may well be necessary. The needed priority setting should be done with input from industry and academia and our industry looks forward to cooperating with NBS in identifying the most important measurement objectives.

Senator GORTON. Mr. Samuel, what would you describe as the special or unique services, equipment, personnel expertise, et cetera, of the National Bureau of Standards which can help the biotechnology industry solve its measurement problems?

Mr. SAMUEL. I think that probably one of the things that is most needed is process technologies, and NBS has expertise in this area. They have developed that in other areas, and we think that some of that would be applicable here. NBS has engineering capacities, and they are very good at helping us develop some of the things that would enable us to transfer research processes into industrial processes. We think they could be helpful by virtue of NBS's unique interdisciplinary approach. NBS's bridges to industry and academia give NBS widespread credibility and will speed the diffusion of technology.

I must say that looking over the possible list of things that NBS could be involved in, I find it a rather long menu. I think some priority setting would be necessary, and that is one area in which I think industry and academia can cooperate with NBS in setting those priorities and making sure that they bring the right kind of personnel to bear on our problems.

Senator GORTON. The next question is for both Mr. England and Mr. Hume.

I would like to have each of you comment or extend your comments about the deterioration of the Bureau's maintenance and dissemination of measurement services. Could either or both of you give an example of a deficiency in the measurement services of the Bureau at the present time and what the cause of this deterioration has been?

Mr. ENGLAND. Mr. Chairman, one area that I could address as an example, I suppose, would be the area of microwave and millimeter wave technology, which we feel has been seriously neglected by the Bureau, and to such a degree that recently—within the last several months—the IEEE organization put together a special committee, and we are—as an organization—cooperating with that committee which is identified as Promote National Microwave Standards, PNMS. They are trying to focus in on this particular critical issue of not having adequate standards for millimeter wave technology, which is, of course, a much needed area.

In this particular area, the people that have been investigating this are indicating to me and to others that they feel that the amount of money needed right now just to cover this one critical area of millimeter wave technology is $5 to $6 million each year for the next 5-year period. That is also part of my written record.

A week ago, just before I came to Washington, I was informed by some members of that particular committee that they have now reestimated or reprojected that number to be $8 million per year over the next 5-year period, which would just cover that one area of millimeter wave technology standards and the dissemination of that technology back to industry.

The development of standards, in my opinion, and certainly a lot of those that have worked in measurement science, is certainly a scientifically intensive activity. It has to be parallel with the development of new technology. And if you are trying to play a catchup role in that area, it is very difficult. It has to be almost concurrent, and most projections would indicate that the leadtime for that development at the Bureau typically has run between 3 and 6 years, more like 5 in this particular example that I gave you.

Thank you.

Mr. HUME. Senator, I have a couple of examples I would like to share with you. Most recently, the National Bureau of Standards is contemplating the change in the value of the U.S. legal volt by some nearly nine parts per million. Now, that change would certainly in one sense be beneficial to this country because it would bring us more in line in terms of the value of the volt with other major European trading partners and Japan.

But the fact that we would have a shift of nine parts per million in that value is a pretty clear indication that there is a lot of room to be improved in maintaining the values of the basic standards that the measurement systems, the standards for our products are based on. There is considerable room for improvement in those standards. And as we look over the last 10 or 15 years, we see tremendous improvement in the industrial capability, but the capability at NBS with the services that it is offering have been relatively flat in terms of any improvement in the performance level.

So now, when we talk about a change in the value of the volt of nine parts per million, it affects the number of instruments which industry has out that are presently calibrated that have to be recalibrated based on that change of nine parts per million by a significant amount.

We have somewhere over 100,000 products in the marketplace today that are installed in customers' facilities that will require recalibration based on the change in the value of the volt. And that is a fairly significant change, and we believe there needs to be considerably fundamental more attention placed in this basic area of measurement standards.

Another I think good example is the fact that we are still in the process of taking our manufacturing systems apart and submitting the pieces essentially of the manufacturing process into a calibration lab for calibration. And now we know as we get more capable and more capable all the time it is impossible to characterize the performance of any one of the pieces independent of other elements of the manufacturing system. So we really need the capability to measure and test those manufacturing systems in site or in place, in location in the operating environment in which it is to be used. And we do not currently have that capability except in some very limited areas from NBS.

Senator GORTON. Thank you.

Senator Gore, I have a markup of the Small Business Committee. Could I ask you to take over for any questions which you or Senator Rockefeller might have, and offer Senator Rockefeller the opportunity for an opening statement as well.

Senator GORE. Mr. Chairman, I would be glad to.

I will, in light of the time, simply submit my questions in writing. If these gentlemen would be so kind as to respond in writing, I would appreciate it.

Senator Rockefeller.

Senator ROCKEFELLER. I have neither an opening statement nor do I at this time have questions, Mr. Chairman.

Senator GORTON. Well, thank you both very much. I also will have additional questions to submit to each of you in writing with hopes that you can help us with this authorization bill.

Thank you all for coming.

We are adjourned.

[Whereupon, at 11:18 a.m., the hearing was adjourned.]

ADDITIONAL ARTICLES, LETTERS, AND STATEMENTS

Statement of D. Bruce Merrifield, Assistant Secretary of Commerce, Productivity, Technology and Innovation, Department of Commerce

Mr. Chairman, we are proposing authorization for the Office of Productivity, Technology, and Innovation, or OPTI, of $1,762,000 in FY 1986, compared to $2,335,000 in FY 1984 and $2,460,000 in FY 1985. The money for fiscal 1986 is to be used for a phase out of OPTI to a small executive staff of about three people beginning in fiscal year 1987.

We believe that termination of OPTI is appropriate now since it has successfully competed its major tasks, specifically:

By the passage of the National Cooperative Research Act of 1984, a major antitrust barrier to cooperation in R&D among U.S. companies has been removed;

OPTI's Industrial Technology Partnerships Program has helped to stimulate over $2 billion of private sector R&D financing through the use of research and development limited partnerships (RDLPs) in the last three years, compared to only $200 million in 1981; and OPTI's Federal Technology Policy program succeeded in drafting and obtaining approval of a Presidential Memorandum that makes contractor ownership of inventions government-wide policy. OPTI also helped to draft provisions that were included in P.L. 98-620, which extends the principle of contractor ownership to some of the largest government-owned, contractor-operated laboratories.

I will continue to work to strengthen the contribution of technical innovation to U.S. competitiveness, economic growth and new job formation. Following are some examples of specific activities that we would expect to continue within the limits of my resources: we will function as the Department's focal point and advocate on policy matters involving productivity, technology and innovation; we will assist the private sector to form cooperative R&D ventures, especially in leapfrog technologies where the R&D efforts cut across traditional industry lines and where Federal laboratories can contribute expertise; and we will continue to foster international cooperative R&D ventures between U.S. developing nation companies based on the very successful BIRD Foundation model with Israel.

The National Technical Information Service (NTIS) will continue to report to me. Self-funding, information clearinghouse activities facilitate the transfer of technology to U.S. firms and are of crucial importance in enhancing the ability of U.S. business to compete more effectively in world markets. Dr. Caponio, the Director of NTIS, will describe several proposals for technical changes to the NTIS organic legislation which will permit it to be even more efficient and effective in carryout out its important mission.

In conclusion, Mr. Chairman, I would like to emphasize that this Nation's continued leadership in the field of technological innovation is critical to our economic growth, the development of sustainable new jobs, and the competitiveness of our industry internationally. We must recognize that more than two-thirds of U.S. industries—whether actually involved in exports or not—now compete in world markets. A simple, yet often overlooked, point is that when a U.S. manufacturer sells his product to someone in the U.S., he is, in fact, competing not just in the U.S. market but in the world market. To regain and maintain world leadership, the United States must capitalize more effectively on its natural advantages, especially its great breadth and depth of scientific research and its unparalled entrepreneurial culture. To do this, we must continue to remove barriers and provide incentives for increased productivity and innovation, and to catalyze cooperate efforts.

Thank you, Mr. Chairman.

Statement of Joseph F. Caponio, Director, National Technical Information Service, Department of Commerce

Mr. Chairman and members of the Subcommittee, thank you for this opportunity to discuss the programs of the National Technical Information Service (NTIS), to

request the authorization of appropriations for NTIS for fiscal years 1986 and 1987, and to request changes to our organic legislation.

The NTIS enabling legislation, which was passed in 1950, (15 U.S.C. 1151-1157) directs the Secretary of Commerce to establish and maintain within the Department of Commerce a clearinghouse for the collection and dissemination of scientific, technical and engineering information. Section 3 of the Act requires that costs of the clearingshouse be paid from sales income, not from tax-supported Congressional appropriations. In 1970, NTIS was established as a primary operating unit of the Department to serve as that clearinghouse. NTIS makes domestic and foreign Federal technological, scientific, economic and engineering information accessible to business, industry, government, and other interested individuals and organizations. Use of the technological information that NTIS disseminates serves to: improve the economic health and growth of U.S. business and industry; increase productivity and innovation in the U.S.; improve the competitive position of U.S. firms in the world marketplace; and promote the use of foreign research results by U.S. industry.

NTIS serves as the primary source for the public sale of Government-sponsored research and engineering reports, reports on Federally-sponsored research in progress, machine-processed data files, and computer programs. As this central source, NTIS provides a full array of information products and services designed to encourage wider use of technology. In FY 1984 NTIS:

Acquired and made available approximately 72,000 (including 21,000 foreign) new Government-sponsored research and engineering reports.

Sold approximately 490,000 copies of documents in paper form and 2,500,000 in microfiche.

Fully recovered by revenue from sales the costs of providing information products and services which were in excess of $30,000,000.

Mr. Chairman, the NTIS clearinghouse operations are 100 percent self-supporting. However, there is one program within NTIS that receives appropriated funds.

PATENT LICENSING

Our Patent Licensing Program is the Government's most active patent licensing program in terms of numbers of licenses and royalties received. We evaluate new technology developed within Federal laboratories to identify inventions with possible commercial potential and promote selected inventions to U.S. industry. Our foreign filing activity assures the protection of U.S. Government-owned technology from unrestricted, uncompensated use by foreign competitors of U.S. industry. In FY 1984 the program successfuliy:

Negotiated 36 patent licenses including 14 exclusive licenses.

Collected receipts of $839,000

Paid cash incentive awards to 96 Federal employee-inventors.

The program has demonstrated that patent licensing is an important mechanism for transferring technology from Government laboratories to the private sector. Under licenses granted, licensees pledge millions of dollars of private investment in R & D and new plant construction, creating new products, businesses and jobs. Receipts collected under patent licensee currently exceed the cost of the licensing activity. Although NTIS charges and retains fees to partially cover the direct cost of licensing, royalty receipts (of $834,000 in 1984) are returned to the U.S. Treasury. Therefore an annual appropriation is required to partially fund the program.

Appropriated funding for the program was $502,000 in FY 1984 and $545,000 in FY 1985. For FY 1986 we request an authorization of $537,000.

CHANGES TO ORGANIC AUTHORITY

Mr. Chairman, I would like to discuss two requested changes in NTIS' enabling legislation as presented in the NBS Authorization Bill submitted by the Administration for FY 1986 and FY 1987. Section 4(a) of the proposed legislation would permit NTIS to obtain printing services at the most economical rates possible. While we envision most of NTIS's printing requirements would still be met through the Government Printing Office, the proposal would offer the flexibility of having printing done elsewhere. The result would be improved control for NTIS over scheduling of production, better quality control, and lower costs. The result for the NTIS customer would be a more timely, higher quality product at lower prices. Section 4(b) of the proposed legislation would give NTIS explicit authority to acquire capital equipment and inventories from receipts. In a recent review by the General Accounting Office, we were advised that our current authority does not specifically permit the acquisition of capital assets (equipment and inventories). NTIS' current authority (15 U.S.C. 1153) states that ". . . the services and functions provided therein shall be

self-sustaining or self-liquidating and that the general public shall not bear the cost of publications and other services which are for special use and benefit of private groups and individuals . . .". Therefore, in order to fullfill our mission and to meet GAO's requirements, we are requesting specific language be added to our organic legislation that would authorize capital asset acquisition or replacement.

That concludes my statement, Mr. Chairman. I shall be happy to answer any questions you might have.

Question. Why should NTIS be allowed to obtain its printing services directly from commerical printers?

Answer. The advantage to NTIS, its customers, and the Government are: NTIS would have the ability to more closely monitor and control the timeliness, quality, and cost effectiveness of its printing program.

Delays in the availability of some reports could result in loss of economic advantage to U.S. industry.

Direct control and contact by NTIS with its printing suppliers.

Timely distribution of current reports prevents costly duplication of research efforts. This is of major importance when we consider that in excess of $50 billion is expected to be spent on Federal research and development in FY 1985.

Reduced turnaround time for print orders (we estimate a time savings of from anywhere of five days to three weeks). This can be attributed to added GPO administrative procedural time.

Because of the nature of our printed products (recent scientific and technical developments) it is imperative the information is made available to our customers in the shortest possible time.

We estimate that going directly to commercial printers would be approximately 5 percent less costly than going through the GPO.

STATEMENT OF DR. DELBERT E. DAY, CURATORS' PROFESSOR OF CERAMIC ENGINEERING AND DIRECTOR, GRADUATE CENTER FOR MATERIALS RESEARCH, UNIVERSITY OF MISSOURI-ROLLA

Mr. Chairman, distinguished members of the subcommittee, I welcome the opportunity to appear before you and to briefly explain why I support the National Bureau of Standards initiative on advanced ceramics. My principal message to you is that a silent competition—some might call it a revolution—is in progress. This competition, which is of vital economic and strategic importance to the United States, is for the world leadership of an entirely new class of technologically important materials known as advanced or high-tech ceramics. The outcome of this competition, which is still in the balance, will be decided in the next decade. The unique scientific and technical capabilities of the National Bureau of Standards can, with proper direction and support, help guarantee that the United States will reap the benefits from the tremendous growth in advanced ceramic materials which will occur in the next few years.

At this point I would like to introduce myself and to mention how I became aware of the ceramics program at the NBS. My name is Delbert E. Day and I am Curators' Professor of Ceramic Engineering and Director of the Graduate Center for Materials Research at the University of Missouri-Rolla. For nearly twenty-five years, I have taught ceramic engineering and conducted research on ceramic materials. I have held several offices in the Glass Division of the American Ceramic Society and the National Institute of Ceramic Engineers. My first exposure to the NBS occurred when I was a college student and used a book entitled "Phase Diagrams for Ceramists". The NBS is probably best known in the ceramics and materials profession throughout the world by its truly superb work in assembling and evaluating phase equilibria data. These diagrams, which show how different compounds will chemically react, are used by industry throughout the world. They are absolutely essential to the manufacture and use of metals, refractories, glass, and cements. Some of these phase diagrams have been called billion dollar diagrams because of the value of the products resulting from them. This cooperation between the NBS and the American Ceramic Society on phase diagrams started in 1933 and is a perfect example of how the NBS can assist U.S. industry by providing technical information and data of considerable commercial value. No private company could ever justify such an effort. The phase diagram program has been so widely used and is so valuable that the Society is now raising $4 million from the ceramics industry to underwrite this work at NBS in the future. In only a few months, $1.4 million has been raised.

I would now like to describe what we mean by advanced ceramics, which are vastly different from the traditional ceramic materials. Advanced ceramics, or as

the Japanese call them, fine ceramics are specially propared high performance materials of unusual properties—hard and mechanically strong, wear and abrasion resistant, lightweight, and chemically inert. These are the materials that will be used for new products such as:

a. The ceramic or high temperature engines which will have much higher fuel effiency than current internal combustion engines.

b. Chemical sensors for detecting and controlling toxic and combustible gases.

c. Multilayer electrical capacitors and other types of electronic and electro-optic devices.

d. Biomaterials including artificial bone, joint, and dental implants. In the next 15 years the market for advanced ceramics is expected to grow from the present $4 billion/year to more than $10 billion/year. Advanced ceramics are high value added materials that will have a major impact on our economy and quality of life.

I hope these brief statements have convinced you of the technological and economic importance of these materials. This importance is apparently widely recognized in Japan where industrial activity is so high that it is referred to as "ceramic fever". Japan now controls about 50% of the current world market for advanced ceramics and has demonstrated an intent to dominate this market to a very high degree.

The effort of U.S. industry to develop commercial products from advanced ceramic materials and to protect our leading position in these materials can be greatly aided by NBS. The development of measurement methods, research on processing and fabrication techniques as they relate to mechanical reliability and reproductibility, the development of standardized reference samples, and the objective evaluation of test data are but a few examples of work that has industry wide value and which is a mandated function of NBS. The NBS can broadly disseminate information that benefits all parties in a technical field. This improves the general level of knowledge in that field and inevitably leads more quickly to commercially available products. The NBS can help U.S. industry remain competitive in the world wide effort to develop advanced ceramics by providing ojective data, information, and standards that serve the entire industry, that are independent of proprietary interests, and which lead to more rapid technological improvements in materials and products.

In conclusion, I have tried to convey my feeling why it is important for U.S. industry to win the increasingly competitive contest for the world market in advanced ceramics. The NBS through its Center for Materials Science can play a major and pivotal role in the commercial development of these materials. The additional funds needed by NBS for this purpose will be an investment that produces new jobs and strengthens the U.S. economy.

Thank you for your interest.

Statement of the National Conference of States on Building Codes and Standards, Inc.

The National Conference of States on Building Codes and Standards is an Executive Branch Organization of the National Governors' Association. NCSBCS was founded in 1967 to nationally coordinate the building code and public safety interests of our nation's fifty states and several territories. Our voting membership is comprised of one governor-appointed delegate from each state and territory. These delegates, for the most part, have the broadest range of responsibility in their state for health and life safety in new and existing buildings.

This written testimony marks the fifth time in the past two years that the states, through the Conference, have provided written or oral testimony before a Congressional Committee in opposition to a proposed zero budgeting for the National Bureau of Standards' Centers for Building Technology and Fire Research.

In his testimony to this Subcommittee last year, our then President and Arizona delegate, Richard E. Wolfe described in detail some of the irreplaceable building technology and fire safety research which these two Centers provide to our states and shared with you the results of a survey we conducted of the states' past, present, and future research projects in the building technology and fire safety areas. We have updated that survey by adding input from 5 other states (making a total of 35 states responding) and have attached a revised summary sheet for your information.

The results of our detailed survey of the states' past, present, and future building technology and fire safety research needs, clearly shows that of the thirty-five states responding, only three states have funded any kind of building or fire safety research. When asked which areas would they conduct studies in if they had state funds available to do such research, nearly every state put forward an almost identi-

cal list of building and fire safety research items. They included: fire toxicity, indoor air-quality, and structural failures.

While the Governors of many of our states have been vocal in their support for Congress' efforts to find ways of reducing the federal deficit, the Conference adamantly maintains, as it has for the past three years, that the elimination of approximately nine (9) million dollars of combined federal funding for the National Bureau of Standards Centers for Building Technology and Fire Research, is neither a prudent nor a practical place to begin to achieve a portion of the federal budgetary savings we all desire.

Between our testimony in March of 1984 and the present, nothing has changed to diminish the urgent need for continued funding for these two vital federal public safety research programs. No state or group of states and local governments have obtained substantial funding to develop comparable technical research facilities or staff, nor provided the coordination of state building and fire safety research efforts which would warrant the zero funding of either the Center for Building Technology or the Center for Fire Research in fiscal year 1986.

Indeed, events over the past twelve months have only further clarified the continued urgent need for the work of the Bureau's two centers. Three such events highlight that point:

Last April, the Conference testified before the House Subcommittee on Investigations and Oversight on the importance for state and local governments for state and local governments to have access to the expertise of the National Bureau of Standards in investigating significant structural failures of public buildings. In that testimony, we described an effort that was being initiated among NCSBCS, the National Bureau of Standards, the Association of Major City Building Officials, and the American Society of Civil engineers to draft "model agreements" between NBS and state or local jurisdictions which could be immediately enacted should a building failure occur. Under such agreements, the Bureau would then be invited into the disaster site with the full legal authority of the city or state behind it, to study and report on the probable cause of such a building failure.

That task force, funded jointly by the Bureau and by its three other member organizations, has prepared a preliminary draft model agreement. On March 20th this task force will meet at Georgetown's Marbury House here in Washington, D.C. to prepare a revised draft which will subsequently be made available to state and local jurisdictions across the country to adopt and have in place should a significant building failure occur.

As we noted before Congressman Gore's Subcommittee last spring, the structural failure expertise of the Center for Building Technology has proven to be an effective force in helping to prevent future structural failures by providing life saving information concerning the technical causes of such collapses.

A second area of vital importance to the states has been the Bureau's continued dissemination to state building and fire officials and the building codes and standards community of the results of the Bureau's research into fire toxicity, smoke control, indoor air-quality, energy conservation, and structural integrity of building materials. This past September, in Denver, Colorado, NCSBCS and the National Bureau of Standards cosponsored the sixth Joint Technical Conference on Research and Innovation in the Building Regulatory Process. As a follow-up to the Denver meeting, this month the Conference sent out its biannual survey of the states' building code departments to ascertain their future building technology and fire safety research needs. As we testified previously, the results of these state research surveys are shared with the Bureau under our Agreement of Cooperation (a copy of that Agreement was contained in Richard Wolfe's March 7, 1984 testimony to this Subcommittee), and are used to help the Bureau prepare its annual research agenda. In turn, the Bureau reports periodically to our states on the results of their research projects.

Thirdly, July 23-25 of this year, the National Bureau of Standards and the National Fire Protection Association will hold a National Fire Research Strategy Conference which will provide national direction and coordinate future public and private research into fire safety. We are actively encouraging the states to participate in that conference.

These efforts in model investigation agreements, dissemination of safety information, and the national coordination of research in building technology and fire safety, are clear examples of the vital work which *only* the National Bureau of Standards can provide on behalf of the American public.

On behalf of NCSBCS, its members and states, the Conference respectfully requests that your Subcommittee once again take the necessary steps to continue to adequately fund both the Center for Building Technology and the Center for Fire

Research. These Centers must be allowed to continue their valuable research and information dissemination which enhance the health and life safety of the citizens of all of our states and territories.

Thank you for providing the states this opportunity to express their views to you again on this vital public safety matter.

SUMMARY OF RESPONSES TO NCSBCS MEMBERSHIP SURVEY—SURVEY OF STATE RESOURCES FOR BUILDING TECHNOLOGY AND FIRE SAFETY RESEARCH

1. Does your current state budget provide for research in:
(a) Building Technology—2 States (Yes) (CA & TX); 33 States (No).
(b) Fire Safety—2 States (Yes) (TX & NY); 33 States (No).
2. If no, why does the current budget not provide for research in:
(a) Building Technology—
State does not have adequate funding to undertake such research (16 States).
This is not a proper function of state government & it belongs at Federal level in NBS (16 States).
(b) Fire Safety—
State does not have adequate funding to undertake such research (16 States).
This is not a proper function of state government and it belongs at Federal level in NBS (16 States).
3. Have past state budgets provided for research in:
(a) Building Technology—33 States (No); 2 States (Yes) TX & A—(indoor air quality in mobile homes).
(b) Fire Safety—33 States (No.); 2 States (Yes) TX & NY—Toxicity
4. If no, why did past state budgets not provide for research in:
(a) Building Technology—
State did not have adequate funds for such research (21).
This function belongs at Federal level (13).
(b) Fire Safety—
State did not have adequate funds for such research (21).
This function belongs at Federal level (13).
5. What major topics are or have been the subject of present and past research efforts?
(a) Building Technology—31 States (None); indoor air quality (2); energy conservation in buildings (2).
(b) Fire Safety—33 States (None); Toxicity (2).
6. If your state is currently conducting research in these areas, in what additional areas of building technology and fire safety is more research needed for which you do not have sufficient funds for your state to undertake?
(a) Building Technology—33 States (N/A)
(b) Fire Safety—33 States (N/A); Toxicity (1); Flamability of room contents (1).
7. If your state does not conduct any research in either or both of these areas, what are your major research needs (eg. toxicity, structural analysis, etc) in?
Structural testing/investigation of structural failures (27)
(a) Building Technology—
Computerization of code processes (7); Indoor air quality (15); Energy Conservation (8); Accessibility provisions (6); Seismic Safety (8).
(b) Fire Safety—
Toxicity (32); Residential sprinkles & smoke detectors (13); Flamability of building contents (13).
8. Attached is a list of some of the more recent research projects conducted by the National Bureau of Standards Center for Building Technology and Center for Fire Research. If either or both of these Centers ceased to operate, which of these research projects would your state independently be able to fund and conduct? (please list)
34 States (None); fast acting sprinkler head system (maybe)—(1).
9. Do you have any comments you wish to share on the prospect of the nonfunding of the Centers for Building Technology or Fire Research?
(See attached sheet for comments from States of Illinois, Indiana, Oregon, Iowa, and Rhode Island.)

List of States that responded to NCSBCS Survey as of 2/28/85.— Alabama, Arizona, California, Colorado, Delaware, Georgia, Idaho, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Montana, Nebraska, New Jersey, New Mexico, New York, North Carolina, Ohio, Oklahoma, Oregon, Pennsylvania, Rhode, Island, Texas, Utah, Vermont, Virginia, Washington, West Virginia, and Wisconsin.

STATEMENT OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS

The Administration's fiscal year 1986 National Bureau of Standards (NBS) budget proposal once again calls for the elimination of the Center for Building Technology (CBT) and the Center for Fire Research (CFR). The rationale is that these programs are more properly the role of the private sector and state and local governments. Frankly, the Society is surprised and disturbed that the Administration is once again trying to zero out these programs. Numerous statements were filed on behalf of a variety of organizations that stressed the valuable role performed by the Center for Building Technology and the Center for Fire Research after the fiscal year 1984 and 1985 budgets attempted to eliminate these programs.

As we did in the last two years, ASCE wants Congress to know that it strongly supports the Center for Building Technology and the Center for Fire Research and opposes the plan to eliminate their budgets in fiscal 1986. The specialized laboratory facilities and the professional staffs of the Center for Building Technology and Center for Fire Research are public resources that should be more fully tapped, not diminished by budgetary concerns.

CENTER FOR BUILDING TECHNOLOGY

The Center for Building Technology is the national building research laboratory. It performs field, laboratory and analytical research to develop measurement techniques and to evaluate the properties of construction materials, components and systems. The program includes substantial efforts in advanced computation and automation, structural engineering, earthquake hazard reduction, building physics, materials and equipment. Civil engineers need sound technical information to make responsible and cost-effective decisions in the building process.

On a larger scale, CBT is the only research program that integrates complex technical issues affecting the vast building industry. Despite the fact that it amounts to about 10% of the GNP, and that almost two-thirds of the nation's wealth is invested in constructed facilities, the building industry is very fragmented. CBT provides a uniform base of information, and serves as a unifying force for the entire industry. Because of the industry's size and diversity, no part of the private sector can duplicate these efforts or adequately distribute the findings on its own. This interdisciplinary laboratory also integrates complex technical issues in a way that more narrowly-focused proprietary research and development cannot.

Some of the unique and valuable aspects of the CBT are:

Unique and comprehensive facilities such as a tridirectional structural test laboratory, 12-million-pound testing machine, environmental chambers, guarded-hot-plate and calibrate hot-box, plumbing tower, anechoic and reverberation chambers;

An integrated, nonproprietary program for removing technological market barriers of the construction industry as well as reducing unnecessary or ineffective building regulations without compromising essential levels of safety. This is the major technical information source for the development of voluntary standards by groups such as ASCE;

A quality assurance program for hundreds of laboratories used by designers, owners, builders and state and local governments responsible for building and transportation.

CBT also provides the authoritative laboratory support for federal agencies that need assistance in developing criteria for the design, construction and maintenance of their facilities. Although we cannot offer a financial analysis, it is likely that the technical support from the CBT provides the federal government with savings in the life-cycle costs of its buildings that annually exceed the budget authorizations for the Center. The elimination of funding for the CBT would result in the loss of a productive investment.

The following case illustrates the vital role CBT provides to the building industry. On January 1, 1985, the management responsibility for the ANSI A58–1982 Standard, "Minimum Design Loads for Buildings and Other Structures," was transferred from CBT to ASCE. This standard is the only nationally recognized voluntary concensus on structural loads in the United States. It is widely used as a resource document by other codes and standards groups, regulatory authorities and engineers confronted with unusual design situations not covered by building codes.

Though management of the Standard will not reside with ASCE, and thereby with the private sector, CBT will continue to be the principal source of new technology to update ANSI A58. CBT programs such as Wind Loads on Buidings, Seismic Design Criteria, Floor Loads, Fire Loads, Reliability Analysis and Design Analysis have been and will continue to provide invaluable input for the standard. Without

future technological support by CBT programs, the future of this important standard will be seriously compromised.

CENTER FOR FIRE RESEARCH

The Center for Fire Research also contributes to public safety in a way that no privately-funded research effort could. CFR explores the processes that initiate, propagate and suppress real fires. As a result, realistic material test methods, cost-effective fire safety design concepts, and new methods of fire control and extinguishment can be developed. Like CBT, CFR does not promulgate or enforce standards or regulations. Instead, it provides technical support to voluntary standards and model codes groups, engineers, the building industry and fire organizations.

Some of the effects of the proposed elimination of the Center for Fire Research include:

Over 100 standard-writing and code committees will lose their source of technical information. None have their own laboratories or technical staffs;

The flow of information to the building industry on fire safety technology will be reduced. CFR operates major programs in sprinklers, smoke control, smoke detection and building design;

CFR's fundamental fire research program is directed at reducing fire protection costs through improved codes and standards and less redundancy in fire protection. The cost of providing fire suppression forces and built-in fire protection for buildings currently exceeds $20 billion annually.

The termination of this important research would essentially stop the development of fire control technology in the United States. If the specter of eliminating life-saving opportunities does not deter efforts to zero-fund the CFR, the cost-saving opportunities should persuade a budget-conscious government to reconsider the proposal. Fire-safe building design techniques can save money for all sectors of our society. Without the CFR, fundamental research programs will stop and engineering criteria will no longer be generated. Such an approach is deleterious to the economic interests of the American people and threatens all our lives.

While the Society applauds and shares the commitment to reduce the federal budget deficit, it also warns against needless elimination of programs that not only are essential but also cannot be duplicated in the private sector. The services provided by the Centers for Building Technology and for Fire Research are invaluable to an important sector of our economy, the building industry. As in the past two years, ASCE is urging Congress to save these vital programs from extinction.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The American Society of Civil Engineers (ASCE), founded in 1852, is the oldest national engineering society in the United States. Membership, held by 100,000 individual professional engineers, is about equally divided among engineers in private practice; engineers working for federal, state or local governments; and those employed in research, industry, construction and academia. The Society's major goals are to develop engineers who will improve technology and apply it to further the objectives of society as a whole, to promote the dedication and technical capability of its members and to advance the professional and economic stature of civil engineers.

NATIONAL ASSOCIATION FOR STATE INFORMATION SYSTEMS, INC.,
Lexington, KY, February 7, 1985.

Hon. SLADE GORTON,
U.S. Senate, Chairman, Subcommittee on Science, Technology and Space, Hart Senate Office Building, Washington, DC.

DEAR SENATOR GORTON: The National Association for State Information Systems (NASIS) is made up of representatives from all three branches of the state and territorial governments who are concerned with effective management of their states' information resources. Our organization has in the past worked with various committees of both Houses, Office of Technology Assessment, General Accounting Office and Congressional Research Service.

My purpose in writing is to express the concerns of our membership about the effect of the sharp budget reductions proposed for the Institute for Computer Sciences and Technology (ICST) of the National Bureau of Standards.

ICST has rendered very valuable service to NASIS members in such areas as flexible media such as discs, database technology, graphics, security procedures and

technology and networking. The state and local government teleconferences have been extremely valuable in getting our late-breaking developments in not only these areas, but on such other topics as micromainframe integration, office automation and institutional cable networks.

The loss of such valuable assistance would have a very negative impact on state information system activities at a time when they provide one of the significant pathways leading to cost containment in state government programs.

I realize that you face many very difficult decisions in reviewing the President's budget, but I hope that you will consider our members' apprehensions when developing your priorities.

Sincerely,

CARL VORLANDER, *Executive Director.*

AOG SYSTEMS CORP.,
Fairfax, VA, February 19, 1985.

Senator SLADE GORTON,
Chairman, Subcommittee on Science, Technology (ICST) and Space, Hart Senate Office Bldg., Washington, DC.

DEAR SIR: My purpose in writing this letter is to express my strong concerns about the 50% funding reduction for the Institute for Computer Sciences and Technology of the National Bureau of Standards.

ICST has a relatively small program which, nonetheless, is critical to the successful development of urgently needed federal, national, and international standards. ICST is uniquely situated to help preserve U.S. industry's competitive position, while supporting both the public's and the government's needs for standards which increase productivity and reduce cost.

The current program is addressing areas of major interest including dictionary and database systems technology, software development methods, security procedures, computer graphics and computer networking. (As the Chair of the American National Standards Committee responsible for developing the Standard for Information Resource Dictionary Systems (IRDS), a critical element in Paperwork Reduction Act and the Reform 88 activities, I am well aware of the role that ICST has played in the development of a Standard for IRDS. Without ICST, the IRDS Standard which is now being prepared for national and international review would not exist for the foreseeable future. The ICST has provided informed leadership and has served as a prime focal point for standards concerned with dictionary systems and the other areas mentioned above. Work in each of these critical areas would be drastically reduced or eliminated under the proposed budget reduction.)

This is the fourth consecutive year that a drastic funding cut has been proposed for the ICST. In the past, Congress has recognized that there is no other private sector or governmental organization which can adequately provide these critically needed services, and has restored the proposed reductions. I recognize the difficult choices which must be made in order to significantly reduce the budget deficit. I hope, however, that it will be possible to continue the current level of funding for ICST, whose role is essential to increasing America's productivity and competitiveness with the rest of the world.

Sincerely,

ANTHONY WINKLER, *Chair.*

NORTHWESTERN UNIVERSITY,
Evanston, IL, February 21, 1985.

Senator SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Senate Committee on Commerce, Science, and Transportation, Hart Senate Office Building, Washington, DC.

DEAR SENATOR GORTON: I am writing to urge your support for funding for the National Bureau of Standards program to upgrade their neutron scattering facilities through the construction of a neutron guide hall and improved instrumentation.

I am soliciting your support because (1) of great personal frustration at my inability to carry out a vital segment of my own (largely government sponsored) research program because of the inadequacy of the available neutron facilities; and (2) the sorry state of neutron scattering facilities in the US has left the American scientific community at a serious disadvantage vis-a-vis their European counterparts.

(1) I have been engaged for several years in neutron scattering research in the field of materials science. This work, sponsored by NSF and DOE, has gained international recognition. It deals with problems involving fatigue failure and microstructural stability in metals, both topics of considerable technological importance. Most of this research was carried out in France, since no American facility is capable of successful execution of the experiments. Access to the French facility now is largely denied to Americans because it is heavily oversubscribed by West European users, so my research has come to a standstill. The proposed upgrading of the NBS facility will permit this type of work to be carried out in the US.

(2) A large segment of research in characterizing metals, polymers, advanced ceramics, magnetic behavior, etc., is closed to US science because none of the US neutron scattering facilities even approach state-of-the-art capabilities.

The Bureau of Standards has a first rate group of scientists, internationally known for excellence in research, who have come up with carefully thought out plans and who will be able to carry them through. The cost is modest; the benefit to the American scientific and technological community enormous. We cannot afford not to have such a facility in the US in this time of scientific and technological competition.

Sincerely yours,

J.R. WEERTMAN,
Professor, Materials Science and Engineering.

APPLIED TECHNOLOGY COUNCIL,
Palo Alto, CA, February 25, 1985.

Senator SLADE GORTON,
Chairman, Science, Technology, and Space Subcommittee, Hart Senate Office, Washington, DC.

DEAR HONORABLE GORTON: I am writing to you on behalf of the Applied Technology Council (ATC) to urge you to support restoration of funding for the Center for Building Technology at the National Bureau of Standards in the budget for fiscal year 1986. We believe the Center has made important contributions in developing performance criteria for buildings, including work on earthquake-resistant design, and this work should continue. Congressional authorization and funding should be provided to insure this.

ATC is a non-profit professional organization engaged in improving design criteria for buildings and bridges subjected to earthquake hazards. Since the early 1970's, we have worked closely with the National Bureau of Standards in the development of practices for cost effective earthquake hazards reduction. Their research efforts, such as recent studies of the standard penetration test for assessment of the liquifaction potential of building sites, provide vital bases for improvement of design and construction practices. Another significant contribution is their leadership of the U.S.-Japan program on earthquake and wind engineering that has made possible vital and cash saving cooperation in studies of large scale structural performance and post earthquake investigations. In addition, their technical support for our private section efforts to develop nationally applicable seismic design and construction provisions has been extremely important. In this case, they have made it feasible to conduct a voluntary, national, cooperative provision development effort involving numerous organizations of owners, designers, manufacturers, builders and regulatory officials concerned with earthquake safety.

It is vital to the nation to have a comprehensive, expert national building research organization to deal with technical issues in the prediction and measurement of building performance. Earthquakes are just one of the important needs that must be addressed. Therefore, it is vital that the Center for Building Technology and the Center for Fire Research continue to exist with adequate funding to continue their important work.

We strongly urge you to support restoration of the funding for these centers and to request the Administration to support these vital causes.

Respectfully yours,

JAMES A. WILLIS, *President.*

MAN-MADE FIBER PRODUCERS ASSOCIATION, INC.,
Washington, DC, February 25, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, U.S. Senate Washington, DC.

DEAR SENATOR GORTON: The Man-Made Fiber Producers Association strongly supports continuation of the Center for Fire Research (*CFR*) at the National Bureau of Standards. We urge that CFR be funded for fiscal 1986 at a level not less than that for fiscal 1985. We have continued to follow and work cooperatively with CFR on research projects which are essential to reduce loss of life and property from building fires in the United States. Regrettably, the fire death rate in this country continues to rank worst, along with Canada, among reporting nations, being over twice the international average. It is encouraging, however, that both the total number of fires and the death rate have been declining over the last several years.

We believe that the National Bureau of Standards through its fire research has contributed valuable and meaningful information towards a better understanding of the complex fire phenomenon. The CFR offers an independence that is not constrained by consideration of market potential and provides essential resources in terms of facilities and personnel for progressive scientific research at the national level. This is demonstrated by development of meaningful, realistic testing procedures to evaluate burning characteristics of building materials and furnishings including textile products of man-made fibers. An outstanding example is the Flooring Radiant Panel test to evaluate the flammability characteristics of carpet for use in corridors and exitways of buildings, particularly health care facilities. The man-made fiber and carpet industries worked closely with the CFR in the development of this most relevant and valuable test procedure that has been widely adopted by federal, state and local agencies.

CFR has demonstrated proficiency in coordinating, under capable leadership, valuable contributions of data and information from academe, industry and public sectors. Such action increases the cost-effectiveness of essential research which will lead to a significant reduction of injuries, loss of life and property from fires. Currently, the CFR is using such data to develop computer models to assess fire hazard and recently announced the availability of the Fire And Smoke Transport (FAST) model. This is a beginning in the development of a most important technique. Such computer models will permit a realistic assessment of the relative contribution of factors including ease of ignition, rate of flame spread, smoke generation and toxicity of combustion products to the overall fire hazard for specified scenarios. Very importantly, such models will provide a rapid and meaningful demonstration of the cost-effectiveness of suppression systems (rapid response sprinklers) and early warning (smoke alarms) for providing life safety in building fires.

Finally, in the past MMFPA has demonstrated support of CFR by providing Research Associates to assist in the Center's on-going program. Currently, our Association, together with other industry groups, plans to make a financial contribution to support part of the on-going CFR research program on fire hazard assessment.

We appreciate this opportunity to state our strong support for the continuation of the CFR at the National Bureau of Standards and the valuable contribution it has made and will continue to make toward the solution of our national fire problem.

Sincerely yours,

PAUL T. O'DAY, *President.*

INFORMATICS GENERAL CORP.,
Woodland Hills, CA, February 25, 1985.

Hon. JOHN C. DANFORTH,
Chairman, Committee on Commerce, Science and Technology,
Dirksen Senate Office Building, Washington, DC.

DEAR SENATOR DANFORTH: My purpose in writing is to express my strong disapproval of the Administration's proposed cut in funding for the Institute for Computer Sciences and Technology (ICST) at the National Bureau of Standards. This is the fourth consecutive year that a drastic reduction has been proposed for ICST. In the past, the Congress has restored the proposed reductions, recognizing that no other private sector or government organization can adequately provide the services prescribed by its mission. This year the outcome is very much in doubt.

As Chairman and President of Informatics General Corporation, one of the country's leading independent computer software companies, I am convinced that by actively promoting international software, database and telecommunications stand-

ards, ICST plays a critical role in enhancing our trade posture and fostering the long-term welfare of our domestic high technology industries. It is essential that U.S. industry not be shut out of foreign markets by one-sided and protectionist standards, and ICST has done much to prevent this from happening.

As head of a major federal computer services and software contractor, I have observed that ICST's development of Federal Information Processing Standards (FIPS), which govern the acquisition and use of computers by federal agencies, has grown in importance and impact directly in proportion to the increase in federal outlays for this purpose—probably in the neighborhood of $20 billion annually for business data processing alone. Conservative estimates put the cost-benefit value of selected FIPS in the several-hundred-million dollar range, in return for a total investment of $10 million for the entire ICST program. In our eagerness to control the federal budget we must be careful not to sacrifice the very progams that help to make control possible.

Finally, as a former industry representative of the National Academy of Sciences Review Panel that oversees the work of ICST, I have been consistently impressed with the quality of the technical staff and the work they produce. For a tiny agency (fewer than 100 professional employees), their output and impact are indeed remarkable. ICST is an island of technical excellence and objectivity in the federal establishment that we can ill afford to lose.

The recommended cuts to the ICST budget would cripple its performance to the point of ineffectuality, and deal a major blow to efforts to improve our balance of trade and control the runaway federal deficit. I urge you to do everything in your power to prevent this from happening.

Sincerely yours,

WALTER F. BAUER, *Chairman and President.*

BUDGET AND CONTROL BOARD,
DIVISION OF INFORMATION RESOURCE MANAGEMENT,
Columbia, SC, February 26, 1985.

Hon. ERNEST F. HOLLINGS,
U.S. Senate, Committee on Commerce, Science, and Transportation, Dirksen Senate Office Building, Washington, DC.

DEAR SENATOR: I am writing to you in behalf of the National Bureau of Standards, Institute of Computer Sciences and Technology (ICST) concerning potential severe reductions in budget for this federal agency.

In our capacity as the organization in South Carolina State Government principally responsible for improving the management of information and communications resources, we have found the services of ICST to be very valuable to the State of South Carolina. In our role as the Division responsible for central management oversight for information technology planning, management, and use, there have been enumerable management publications and guidelines provided by the Institute for Computer Sciences and Techonology which we have found very useful and helpful to the state. In particular some of these relate to the management and acquisition of personal computer hardware ansd software as well as security of personal computer systems.

The special publications of this type that we have received from the Computer Science and Technology Institute are management guidelines for federal agency use which have significant applicability to the management of these information technology resources in State Government. In State Government, as you are probably aware, we do not have adequate resources to develop these type management guidelines on an independent basis and find these special publications to be of significant benefit to us.

Some of the most notable of these special publications which we have found very useful are as follows:

1. Special Publication: 500-103, "Future Information Processing Technology, 1983."

2. Special Publication: 500-119, "Future Information Technology—1984 Telecommunications."

3. Special Publication: 500-102, "Microcomputers: A Review of Federal Agency Experiences."

4. Special Publication: 500-120, "Security of Personal Computer Systems: A Management Guide."

In addition to the valuable publications, the Institute is producing and sharing with state and local govenments, they are providing services in other forms such as

the state and local governments teleconferences which link up states and local governments together to discuss topics such as microcomputer and mainframe integration, office automation, cable networks and etc.

We feel this bureau is providing invaluable information assistance to state government organizations such as ours and encourage you to give every consideration to them allowed to continue to provide these valuable services to state and local governments.

Sincerely,

TED L. LIGHTLE, *Director.*

COUNCIL OF AMERICAN BUILDING OFFICIALS,
Falls Church, VA, February 26, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, U.S. Senate, Hart Senate Office Bldg., Washington, DC.

DEAR SENATOR GORTON: The Council of American Building Officials (CABO) wishes to express its concern over the proposed 1986 budget cuts within the U.S. Department of Commerce involving the elimination of the Center for Building Technology (CBI) and the Center for Fire Research (CFR) within the National Bureau of Standards (NBS).

CABO is a consortium of the three major model code organizations—Building Officials and Code Administrators International, International Conference of Building Officials and the Southern Building Code Congress International—whose members are responsible for creating and enforcing building regulations in more than 10,000 jurisdictions throughout the United States. CABO serves to enhance, at the national level, the continuing efforts of its members in the interest of public health, safety and general welfare. Each CABO member publishes model codes for building, plumbing, mechanical fire prevention and other related documents that are available at low cost for adoption by any local or state unit of government anywhere in the world.

The competitive nature of the building industry forecloses certain areas of basic research. Simply put, the kinds of research which could be performed by NBS are those which profit oriented companies and their associations are not likely to perform. In past years, NBS has done research studies which were helpful in the formulation of building code requirements. This type of research can reduce the loss of life and property due to fire or assist to provide safe housing at an affordable price. On this basis, CABO suggests that favorable consideration should be given to continued funding of the CBI and CFR.

The Memorandum of Understanding between NBS and the National Institute of Building Sciences (NIBS), that was signed in October, 1983, has brought about more private sector participation in the development of the research agenda for both CBT and CFR. NIBS is, we believe, the appropriate vehicle for continued private sector involvement with the CBT and the CFR of the National Bureau of Standards. This vehicle provides the assurance that CBI and CFR will continue to conduct the kinds of research that is helpful in the formulation of building code requirements and would not otherwise be funded.

CABO urges the Congress to provide necessary operational and research funds for the CBT and CFR so as to assure the continuity of generic research and the development and maintenance of facilities required by non-profit, non-mission oriented research.

Sincerely,

RICHARD P. KUCHNICKI, *Executive Director.*

E. I. DU PONT DE NEMOURS & CO.,
Wilmington, DE, February 26, 1985.

Hon. SLADE GORTON,
Chairman, Senate Commerce Subcommittee on Science, Technology and Space, Hart Senate Office Bldg., Washington, DC.

DEAR MR. GORTON: I read with considerable interest in a recent issue of Chemical and Engineering News that funding for the National Bureau of Standard's COLD NEUTRON RESEARCH FACILITY (CNRF) was receiving favorable consideration from the federal government. This letter is written in support of CNRF.

Neutrons have the unique property in scattering and spectroscopic studies of allowing one to make measurements in "in situ" environments. It is thus possible to

define at an atomic level the response of a system under the same temperature, pressure, and chemical environment as is used in real world operating conditions.

The low energy probing which is possible with cold neutrons permits one to examine in detail the diffusion of molecules or atoms in solids, the reorientation and absorption of molecules in catalysts, polymer configurations and dynamics, layered or "packaged" electronic materials, and protein structure and motion in solution.

CNRF would provide a research capability which is not available elsewhere in North America, the closest alternative being in Grenoble, France. The research directions of modern technology are particularly well represented at NBS in the areas of ceramics, alloys, electronic materials, polymers, biomolecules, and catalysts.

During the past four years, Du Pont scientists have worked interactively with the staff at NBS on research projects with considerable success. The CNRF would permit the extension of that collaboration into numerous new areas of mutual interest. Cold neutron measurement technology would be of great importance to the research needs of science in industry as well as academics in the United States.

Thank you for your consideration of this project.

Sincerely,

GALEN D. STUCKY, *Research Leader.*

UNIVERSITY OF MARYLAND,
College Park, MD, March 6, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Senate Committee on Commerce, Hart Senate Office Bldg., Washington, DC.

DEAR SENATOR GORTON: I urge you to support the request by the National Bureau of Standards (NBS) for funds to construct the Center for Cold Neutron Research and associated Guide Hall. As you know, this project has been given a very high priority for the Nation's materials research effort by various national panels. I will not repeat their arguments here, but simply point out the value of that facility for our research program at the University of Maryland. Under support of the Department of Energy, my group has developed a method for analyzing materials using a neutron beam from the NBS reactor. This method is quite useful for detecting many elements that are almost impossible to observe by other methods, e.g., boron, cadmium, and several rare earth elements. Under present conditions, the method is not very widely used because the sources of neutrons outside of reactors are not very strong. But if the cold neutron facility is constructed, the neutron beams available will be about one thousand times stronger, making our method very useful in many practical and fundamental studies. It will be of great value in studies of natural importance ranging from the problems of acid rain to those of toxic and/or trace elements in various materials. In addition to our research work *per se*, we have trained about thirty Ph.D. graduate students at the NBS reactor over the past decade, many of whom are now filling vital roles at laboratories such as Los Alamos National Laboratory.

In summary, I hope you will support the NBS facility. Even in this time of very tight budgets, we must spend money needed for facilities that are vital to the future of Nation's scientific effort, with ultimate economic and other practical benefits.

Sincerely,

GLEN E. GORDON, *Professor of Chemistry.*

THE FLORIDA LEGISLATURE,
JOINT COMMITTEE ON INFORMATION TECHNOLOGY RESOURCES,
Tallahassee, FL, March 7, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Hart Senate Office Bldg., Washington, DC.

DEAR SENATOR GORTON: It has come to my attention that a major budget cut for the National Bureau of Standards, Institute of Computer Science and Technology (ICST) has been proposed. As Chair of the Florida Joint Legislative Committee on Information Technology Resources, I am most concerned since the ICST has been of tremendous assistance to Florida in developing our own information technology resources policies.

Specifically, the ICST played a significant role in the development of our state legislation and subsequent implementation of a computer security law in 1984. Sev-

eral experts from ICST testified before our committee on the need for such legislation and provided assistance to staff in reviewing both the report and legislation.

The committee's latest work on the issue of remote computer access to public records was also assisted by the ICST staff. They provided us with names of other federal officials to contact who were particularly knowledgeable and involved in a similar project. The information we received from these contacts was most useful in preparing the committee's report.

Aside from what ICST has specifically provided to Florida, I am concerned that the budget cut will jeopardize the states' ability to seek unbiased technological expertise. The need for such expertise is increasing as technology impacts to a greater degree on our lives. Therefore, I urge you to restore the ICST budget. Without these funds, the ability of states to get the technical assistance they need in the area of information technology will be compromised.

If I can provide further information concerning Florida's use of ICST or assist in efforts to obtain adequate funding for ICST, please let me know.

Sincerely,

ANNE MACKENZIE, *Chair.*

THE FLORIDA LEGISLATURE,
JOINT COMMITTEE ON INFORMATION TECHNOLOGY RESOURCES,
Tallahassee, FL, March 7, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, U.S. Senate, Hart Senate Office Bldg., Washington, DC.

DEAR SENATOR GORTON: I understand that, once again, a major budget cut has been proposed for the Institute of Computer Science and Technology (ICST) in the National Bureau of Standards. I am most concerned about this based on the assistance Florida has received from the ICST, and the invaluable role they serve in the complex and dynamic field of high technology.

The ICST has been of tremendous assistance to Florida in the development of our own information resource policy for state government. They have provided committee members and staff with briefings on current technology and have been especially helpful to us in developing our security legislation in 1984 and in the long-range target of statewide network development.

One particular benefit of the ICST, which would be a great loss from the budget cut, is their work in devoping standards. I believe the Federal government must continue to lead this efforts. Standards in the computer industry will promote a competitive information technology market, increase innovation and permit the market forces to establish prices.

Once again, I want to convey to you my deep concern over these proposed budget cuts. The ICST has been and continues to be of tremendous assistance to Florida. I would hate to loss the unbiased technological expertise they offer.

If I am provide further information concerning Florida's use of ICST or assist in efforts to obtain adequate funding for ICST, please do no hesitate to call.

Sincerely,

GEORGE STUART, JR., Senator

NATIONAL RESEARCH COUNCIL,
COMMISSION ON PHYSICAL SCIENCES, MATHEMATICS, AND RESOURCES,
Washington, DC, March 8, 1985.

Hon. Senator SLADE GORTON,
Chairman, Subcommittee on Science, Technology, and Space, Committee on Commerce, Science, and Transportation, Washington, DC.

DEAR SENATOR GORTON: I am pleased to write to you about the recent report of the National Research Council which sets forth priorities for federal support of major materials research facilities, and to highlight those recommendations related to cold neutron research at the National Bureau of Standards.

My name is Frederick Seitz. I have been a member of the National Academy of Sciences since 1951 and seved as its President from 1962 to 1969. Since then I have been at Rockefeller University, serving as President from 1968 to 1978.

About a year ago the National Academy of Sciences was asked by the Office of Science and Technology Policy to organize a committee to review U.S. needs for Major Materials Facilities, and to establish priorities for the provision of such facilities. Dr. Dean E. Eastman and I served as Co-Chairmen of that committee; a list of

its members is attached. The Committee completed and delivered its report titled "Major Facilities for Materials Research and Related Disciplines" to OSTP and the sponsoring federal agencies, DOE and NSF on July 24, 1984.

Let me outline for you the major conclusions and recommendations of our report.

SCOPE

The report deals solely with major facilities. That was the Committee's charge. The facilities considered were those that are national in scope, with initial costs on the order of $5–10 million or more intended primarily for research on materials. However, the Committee noted that materials research done on a laboratory scale is equally vital to the future strength of U.S. materials research. Support of laboratory-scale science is complementary to, not competitive with, the support for major facilities recommended.

A continuing concern throughout the Committee's deliberations was the possible misinterpretation of its report. As is emphasized several times the knowledge generated by materials research comes from diverse research styles and performers, each vital to the total effort and each complementary to the other. Those varying styles must each be well supported, for the health of the total effort in materials research. Therefore, the recommendations in the report should be read and interpreted for what they are: a statement as to priorities solely for major materials facilities. The Committee did not address, and the report does not imply, any judgments on the total spectrum of work embraced by materials research.

PRIORITIES

The report presents priorities both for new facilities and new capabilities at existing facilities with initial cost of a least $5 million. The new facilities in order of priority are: a 6 GeV Synchrotron Radiation Facility; an Advanced Steady State Neutron Facility a 1 to 2 GeV Synchrotron Radiation Facility; and a High Intensity Pulsed Neutron Facility. The new capabilities at existing facilities in order of priority are: centers for cold neutron research, incorporating guide halls and instrumentation; insertion devices on existing synchrotron radiation facilities; an experimental hall and instrumentation at the Los Alamos National Laboratory Pulsed Neutron Source; upgrading of the National Magnet Laboratory; and enriched pulsed neutron targets.

COLD NEUTRON RESEARCH

With respect to cold neutron research, which is germane to the NBS budget, I would like to quote from the executive summary ". . . the immediate implementation of at least one instrumented cold neutron guide hall is necessary to provide forefront capability." In fact, as noted above, the provision of an internationally competitive cold neutron research capability was the highest priority recommendation among opportunities for new capabilities at existing major materials facilities in the United States. The report establishes both the urgent need for this capability and the opportunity that exists at the National Bureau of Standards to meet this need in a cost effective manner.

During our deliberation, NBS was asked to present their proposal both to the subpanel on neutron scattering and to the full committee. Their presentation, along with all of the presentations for new or enhanced facilities, was published as an appendix to the committee report.

First, let me say on behalf of the committee that we are very pleased to see this proposal in the budget for the Fiscal Year 1986, and hope that you will be able to act favorably on this request which will allow work on this vital project to proceed. The NBS proposal is based on the availability of a large volume cold neutron source that will be installed in the 20 Megawatt Research Reactor, a project that was approved in the budget for Fiscal Year 1985. The special features of this cold neutron source present an opportunity to develop a truly national facility, that can help to fill the critical gap in U.S. cold neutron research capability identified by our committee. The industrialized nations in Western Europe have already developed extensive capability in this new research area.

The proposal before you now is to allow development of a large cold neutron research facility, to be located adjacent to the existing reactor building. One of the special properties of cold neutrons that make this such an opportunity is the fact that cold neutrons can be transported over many tens of meters with very small losses in intensity. This allows many instruments to be served by the cold neutron source, provided that the source geometry allows the installation of many neutron

"guides" well separated in angle. Since the NBS reactor was designed to allow such access, provision of adequate experimental space such as that proposed will provide at least 15 experimental stations, a number that will allow for development of the instruments required to give U.S. researchers access to the latest types of neutron instrumentation. Our committee concluded that access to such instrumentation is essential if U.S. materials research is to match the growing capabilities in Europe and Japan.

The proposed facility would be operated as a national user facility, with equal access for all qualified American researchers. This is an important aspect of this and any other major facilities that may be approved. They must provide their measurement technology to the entire nation, so that the best use is made of what are, of necessity, limited resources. The proposed mode of operation provides ⅔ of the operating time on the eleven experimental stations to general users, with the time to be allocated by a Program Advisory Committee with wide membership. The remaining ⅓ of the time would be available for NBS use. In addition, space for at least 4 experimental stations will be made available for development by outside parties such as Participating Research Teams (PRT's). These stations would be designed, constructed and maintained by the PRT in return for a guarantee of ⅔ of the available time. The remaining ⅓ of the time would be available to general users. This mode of operation provides for both the general user, who needs a limited amount of time on many different instruments, and the more specialized user, who needs guaranteed access to a specific instrument for long periods of time. The arrangement ensures the most efficient utilization of the facility by all interested researchers, and provides the broad range of experimental techniques that are required to allow the U.S. to establish a competitive position in this critical area of materials science.

As the report emphasizes, cold neutron research impacts on many areas of materials research and technology. To quote again from our committee's recommendations: ". . . Cold neutron facilities are urgently needed to address the rapid expansion of neutron applications in materials science, chemistry and biology. Many central problems in these sciences can only be solved using new instruments with cold neutron beams." The NBS proposal contains the instruments that are required to serve this diverse need which extends over virtually all of our materials-based sciences ranging from solid state physics and metallurgy to chemistry and bio-technology. They proposed eleven experimental stations for the general user community in the broad general areas of instruments to study microstructure (in e.g. metal alloys, polymers and composites, biological assemblies and cermics); the very slow motions of molecules (e.g., polymers in solution, biomolecules in solution, molecules in and on the surface of catalysts, and ions in new battery materials); the properties of materials with phase transitions, the dynamics of novel magnetic materials and the coupling of different types of motion); the atomic-scale behavior of impurities in metals and of molecules in chemical compounds (e.g. the trappings of hydrogen at impurities in metals, the movement of molecules diffusing in chemical compounds and the motions of atoms or molecules in liquids); and the distribution of atoms in solids (e.g. depth profiling of key impurities in semiconductors, the structure of protective films on electronic devices and the presence of trace amounts of elements such as hydrogen in bulk materials). As you can see from this description, this facility would serve a very broad array of users and provide them with an essential measurement technology that is not currently available in this country.

Finally, I would like to discuss cost-effective use of the nation's large facilities. The NBS proposal will provide this capability at a cost much less than would be required to build a totally new facility (our estimate is that a new facility would cost at least 5 times as much as this proposal and require more than to develop). The proposed investment to serve the demonstrated need for cold neutron research is quite modest when compared to the existing and approved investment in Western Europe and Japan (over $200 million). This proposal builds on existing facilities and programs, in order to make the best possible use of limited resources, and to provide the basis for needed improvements in or nation's neutron research capability in the future. The research reactor at NBS is part of an existing Center for Materials Science that is engaged in a broad range of materials research. Such a location would provide an optimum environment for the new capabilities to be provided.

Thank you for your interest in our report; I am enclosing a copy.

Sincerely yours,

FREDERICK SEITZ, *Cochairman.*

AMERICAN ASSOCIATION OF STATE HIGHWAY
AND TRANSPORTATION OFFICIALS,
March 11, 1985.

Hon. SLADE GORTON,
Chairman, Senate Subcommittee on Science, Technology, and Space, Hart Senate Office Building, Washington, DC.

DEAR SENATOR GORTON: I understand your Subcommittee has scheduled hearings and plans to take up the question of new authorization for the National Bureau of Standards in the near future. I further understand that the Administration's FY 1986 budget request for the NBS calls for, among other things, the elimination of the Center for Building Technology. It is about this last matter that I am writing to you.

The American Association of State Highway and Transportation Officials (AASHTO) is the national association of state departments of highways and transportation. Among their duties dealing with all transportation modes, the state agencies comprising AASHTO are responsible for planning, designing, constructing and operating the nation's principal system of highways. An important part of that responsibility is an adequate program of quality assurance with respect to the materials used in the construction and maintenance of our highways. This quality assurance role is accomplished through a material division in each of the departments, each of which operates one or more materials laboratories to conduct the necessary testing and evaluation.

Recognizing the importance of consistency in such materials testing across the country, the AASHTO Materials Reference Laboratory (AMRL) was established in 1965 under an agreement with the National Bureau of Standards. The purpose of the AMRL was and is to provide a quality assurance program for the state materials laboratories themselves. This has been accomplished through two programs, both of which now are done by the AMRL under the overall auspices of the National Bureau of Standards and its Center for Building Technology. These are:

A sample reference program wherein test results from participating laboratories on soil and asphalt samples prepared from a central source are statistically evaluated for consistency, and

A physical inspection of the state laboratories and their equipment, conducted on a rotation cycle of approximately 30-months duration.

While it is managed by the NBS, the costs of the AMRL program have been borne principally by the state departments involved, with assistance from the Federal Highway Administration, on billings made to AASHTO by the NBS. Other financial resources have been received through fees paid by outside laboratories, who have chosen to participate. None of the needed resources have been provided from funds appropriated for NBS, since the NBS bills us for all the costs involved.

With the perspective of 18 years hindsight, the AMRL program has indeed been a success. The state highway and transportation departments have been afforded a sound, well managed mechanism to assure the quality and consistency of their materials laboratories and attendant procedures. While there has been no financial benefit to the states resulting from the connection with NBS, because of their billings to us, we feel their involvement has been pivotal to our success for several reasons. Among these are the prestige and clear unassailability attendant to the involvement of, and objective management by, the nation's principal scientific measurement agency, its NBS. Another is the distinct absence of a federal regulatory role; the service provided through the NBS merely provides a basis on which the states may regulate themselves. We fear these important factors could be lost if the proposal for elimination of the Center for Building Technology is approved. That there would be some other unit within NBS to which AMRL could be attached seems problematical at best, and very likely impractical.

There is another similar program also now in jeopardy by such an elimination. This is the Cement and Concrete Reference Laboratory (CCRL), sponsored through NBS in virtually an identical fashion by the American Society for Testing Materials (ASTM). Our state highway and transportation departments avail themselves of this service coincidentally with that afforded by AMRL, and compensate the CCRL program through fee payments. These two programs are closely related in that they each serve many of the same clients and are now managed by the same NBS employee. Thus, many of the comments on AMRL, above, are equally applicable to CCRL.

I would be pleased to provide any additional information you may wish. Simply call me or my Deputy Director, Mr. David Hensing, at 624-5800.

Very truly yours,

FRANCIS B. FRANCOIS, *Executive Director.*

SIMCO ELECTRONICS,
Santa Clara, CA, March 11, 1985.

Senator SLADE GORTON,
Hart Building,
Washington, DC.

DEAR SENATOR GORTON: I am offering written testimony on the Initiative for Process and Quality Control which is before the U.S. Senate Committee on Commerce, Science, and Transportation.

I support the need to recover cost for government services where there is comensurate commercial trade to support this cost recovery. There are, however, situations such as the Quality Programs of a commercial interprise which do not directly produce sales and therefore must be evaluated in a different way. The National Bureau of Standards is engaged in work which will ultimately improve the Process and Quality Control used in Industry. This work involves improving the knowledge of measurement processes and ultimately transferring that knowledge to decision makers in U.S. Industry.

The Japanese have made the most of Government supported research to advance the state of the measurement and control Science. The utilization of this information has resulted in the most efficient and quality conscious society in the world and has resulted in devastating losses of trade for U.S. producers. It is a logical task of the National Bureau of Standards to place the United States in a measurement and quality control leadership position among Nations, just as it is a logical task for the Armed Forces of the United States to maintain a Military readiness second to no Nation.

I am speaking as a U.S. citizen and as the President of a service company that depends on the high quality technical support of the the National Bureau of Standards.

Please consider the effect of the continued erosion of one of the Great National Resources, The National Bureau of Standards, should the NBS budget fail to fund necessary industry support by the Bureau one can only expect a further sinking of the status of the U.S. in Technology leadership. The Company I work for, SIMCO electronics, is a Calibration Service Company that performs approximately 40,000 calibrations for Industry in the San Francisco Bay area.

This economical calibration service has been partly responsible for enabling the high technology industries to flourish in the "Silicon Valley". The calibration service business has been very competitive and SIMCO has evolved into a very efficient operation. We feel that we are not the ultimate recipient of an NBS service. We distribute the NBS derived accuracy to our customers who are often on the leading edge of technology. Our small business can not support a major portion of the NBS funding on a cost recovery basis. I feel that the impact of budget cuts at NBS on U.S. Industry's technology leadership and on U.S. Industry's competitive position is already being felt.

I would like to recommend that NBS be given full funding for the Process and Quality Control Initiative.

Respectfully submitted,

CARL QUINN, *President.*

NATIONAL FOREST PRODUCTS ASSOCIATION,
Washington, DC, March 12, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Russell Senate Office Building, Washington, DC.

DEAR MR. CHAIRMAN: The National Forest Products Association (NFPA), a federation of lumber and wood products associations, supports the activities of the National Bureau of Standards (NBS) Center for Fire Research and is concerned that authorization for its continuing work is not included in the Administration's proposed fiscal 1986 budget.

The goal to reduce fire fatalities and fire loss in the United States is very significant to the industry and has been endorsed by many members of Congress. Much of the necessary basic fire research to address this issue on a national basis is underway or contemplated at the Center for Fire Research.

Many wood and non-wood building material manufacturers are involved in research on fire performance of their products. Regulatory acceptance of these products is based upon national fire performance and test standards. Such standards are dependent upon credible basic research and evaluation provided by the Center for

Fire Research as an essential sevice to the regulatory and scientific community. Development of quantitative tools for fire safety prediction and evaluation, including new computer methodology, is the unique contribution of the Center for Fire Research. It would be costly and lacking in credibility for different segements of the industry to attempt to replicate the work of the Center.

The National Forest Products Association is strongly supportive of efforts to control federal spending; however, the activities of the NBS Center for Fire Research are of such a priority nature that they should be continued through a reallocation of budgeted funds.

We respectfully request that our statement be incorporated into the record on the fiscal 1986 budget request for the National Bureau of Standards.

Sincerely,

SCOTT SHOTWELL.

NATIONAL FOREST PRODUCTS ASSOCIATION,
Washington, DC, March 25, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Russell Senate Office Building, Washington, DC.

DEAR MR. CHAIRMAN: In our letter of March 27, 1985, the National Forest Products Association recommended continuation of the beneficial work of the National Bureau of Standards Center for Fire Research (CFR). The following specific information is provided in further support of that position.

Is is the general view of the National Forest Products Association that basic fire research performed by the CFR is needed to provide a rational approach to national fire requirements and as a background for required fire research studies. The CFR is recognized as the world leader in development of mathematical fire models and computer simulation. As a result of this work, it is not possible to predict, through modeling, the spread of smoke, toxic gases and heat from a fire in a room to other parts of a building. These techniques will establish the basis for improved fire safety while providing designers, builders and regulatory authorities with the capability to provide the necessary fire safety at reduced costs with greater design flexibility. This work is in its infancy and should be continued.

Concerns with combustion (smoke) toxicity in fires have surfaced in many states throughout the country. The CFR has developed a test procedure for measuring combustion toxicity of materials. This methodology has received wide recognition in the scientific community and is presently undergoing review in the American Society for Testing and Materials. It is important that this effort be continued.

CFR has also been the leader in the development of a test method for measuring rate-of-heat release. This concept is of special significance to the building industry since it determines the rate at which a material actually contributes heat to a fire. This association, through the Research Associate Program at the National Bureau of Standards, participated in developing a heat release test method. This work contributes to the success of the fire modeling program and should be continued.

These examples of current and ongoing work at the Center for Fire Research, in our view, clearly support the need for funding continuation of the Center for Fire Research at the National Bureau of Standards. We urge your support.

Sincerely,

SCOTT SHOTWELL.

ATLANTIC CEMENT CO., INC.,
Stamford, CT, March 13, 1985.

Hon. SLADE GORTON,
U.S. Senate, Senate Office Building,
Washington, DC.

DEAR SENATOR GORTON: I am writing you to express my deep concern over the proposed elimination of the NBS program on Building Research from the NBS FY 1986 Budget.

It is contended that this research is more properly the role of the private sector, state and local governments. I respectfully submit that this is not so; that to abandon the program is to abandon the responsibility of Federal Government in a sector which amounts of 10 percent of the Gross National Product. By its very nature, the program of the CBT can be done only at Federal level and it is naive to believe otherwise.

I call your attention to the attachment to this letter which describes in succinct terms the dire consequences of abandonment of the CBT, a $3.1 million program. In particular:

1. The loss of the only integrated, nonproprietary program aimed at removing technological market barriers of the construction industry, stimulating private sector R&D and contributing immeasurably to voluntary standards by organizations such as the American Society for Testing and Materials and the American Concrete Institute.

2. The loss of Cement and Concrete Testing Laboratory which, in conjunction with the American Society for Testing and Materials and the American Association of State Highway Transportation Officials provides 580 public and private construction materials laboratories nationwide with inspections of test equipment to strengthen quality assurance for building and transportation facilities.

I urge you, as Chairman of the Subcommittee on Science, Technology and Space to use every means within your power to preserve the CBT and its programs so crucially important to the construction industry.

Yours very truly,

L.U. SPELLMAN, *Executive Vice President.*

UNIVERSITY OF CALIFORNIA, SANTA BARBARA,
Santa Barbara, CA, March 14, 1985.

Senator S. GORTON,
Hart Senate Office Building,
Washington, DC.

DEAR SENATOR GORTON: In recent discussions with colleagues at NBS, I have learned that an important science initiative will be a subject of hearings before your Subcommittee. Therefore, I am writing to express my strong support of the proposed NBS Center For Cold Neutron Research.

Over the last year, I have had the opportunity to conduct some experiments at NBS Small Angle Scattering Facility. The work has helped to establish a scientific basis for understanding of the embrittlement of nuclear reactor pressure vessel steels. This research is aiding development of new NRC regulations, which promise a significant improvement in forecasting operating nuclear reactor pressure vessel safety margins.

Pressure vessel embrittlement is only one of several research problems which we are working on that can be studies using small angle neutron scattering. I have been greatly impressed by the scientists at NBS; they have both been gracious hosts and enormously helpful collaborators. Unfortunately, access to neutrons is limited relative to demand. Clearly, the proposed new guide hall and associated instrumentation is desperately needed by both NBS and guest workers if they are to accomplish important scientific and technological objectives. I firmly believe that this project is in the national interest. I hope my comments will be of some use in your important deliberations.

Sincerely,

G. ROBERT ODETTE,
Professor of Nuclear Engineering.

HOUSE OF REPRESENTATIVES,
Washington, DC., March 15, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology, and Space, U.S. Senate, Washington, DC.

DEAR SLADE: As you examine the Administration's FY1986 budget submission, I would like to draw your attention to the proposed 50 percent cut to the funding of the Institute for Computer Sciences and Technology (ICST) of the National Bureau of Standards. Although ICST has a relatively small program, currently funded at only $10 million, I believe that it is a critical national resource for the development of urgently needed federal, national and international computer technology standards.

The current ICST program addresses areas of major national interest including software development and maintenance, database technology, computer security, and computer networking. Government-wide benefits of over $600 million are expected from only a portion of ICST's products in these areas. The proposed budget cut will result in the drastic reduction or elimination of much of this work.

In addition to providing informed leadership and guidance to the Federal Government, ICST serves the dual role of assisting the private sector. It promotes international standards that preserve U.S. industry's competitive position, while supporting users' needs for standards to increase productivity and reduce costs. It is uniquely situated to be an effective, impartial negotiator in the standards development process, providing a forum for mutual cooperation on standards that private companies can not provide themselves because of possible anti-trust implications.

This is the fourth consecutive year that a drastic funding cut has been proposed for the ICST. In the past, Congress has restored the proposed reductions, recognizing that no other organization can adequately provide these critically needed services.

ICST is very important to America's productivity and its competitiveness with the rest of the world. It is a program that pays for itself many times over. I hope that you will find it possible to support a continuation of the current level of funding for this essential effort

Very truly yours,

ROBERT T. MATSUI,
Member of Congress.

NATIONAL ROOFING CONTRACTORS ASSOCIATION,
Chicago, IL, March 15, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Commerce; Committee on Commerce, Science and Transportation, U.S. Senate, Washington, DC.

DEAR HONORABLE SENATOR GORTON: I am pleased to be able to provide you with more detail concerning the outstanding cooperation that has been and continues in existence between the National Bureau of Standards, a Division of the Center for Building Technology, and the National Roofing Contractors Association. Specifically, let me report to you on just two outstanding and extremely valuable activities:

1. This association and the National Bureau of Standards started in the early 1970's, a conference on roofing technology. This conference has continued through the years and such a conference is held once every two years, jointly sponsored by the National Bureau of Standards and NRCA. These conferences have basically been for the study of technology within the roofing industry and basically presented for the benefit for the construction community in the United States. In 1977, this association, together with the National Bureau of Standards, sponsored the first International Symposium on Roofing Technology, held in the United States. This was an outstanding success and brought about a presentation of approximately 32 papers dealing with various technical aspects of roofing systems construction. We are currently in the process of planning and conducting the Second International Symposium to be held at the National Bureau of Standards. This symposium is being co-sponsored by the National Bureau of Standards, the National Roofing Contractors Association and RILEM (an international body of testing laboratories). The Second International Symposium will include the presentation of 80 papers on various aspects of roofing technology and will, we are confident, draw an attendance of approximately 1200 construction industry people who are vitally concerned with roof system performance.

2. Over the years through the National Bureau of Standards, the roofing industry has been advanced with the development of research and study. I sight for your information, the following National Bureau of Standards technical studies:

NBS No. 9—Building Science Series—Thermal Shock Resistance for Built-Up Roofing;

NBS No. 55—Building Science Series—Preliminary Performance Criteria for Bituminous Membrane Roofing;

NBS No. 89—Monagraph—Effects of Thermal Shrinkage on Built-Up Roofing;

NBS No. 92—Building Science Series—The Viscosities of Roofing Asphalts at Application Temperature;

NBS No. 473—Technical Note—Laboratory Field Comparisons of Built-Up Roofing Membranes; and

NBS No. 863—Technical Note—Fatigue Tests of Bituminous Membrane Roofing Specimens.

I think it is obvious and self-explanatory that the work of the Center for Building Technology and the National Bureau of Standards is directly and practically useful and helpful to the roofing industry as well as to the entire construction community. I again urge your committee to be sure to restore funds so that this vital activity can continue. The United States has certainly not been a leader in the area of mate-

rial and systems research and technology for the construction industry in terms of countries of the world. To cut back on such a critical and important function would be serious error in terms of the longer term benefit of the country as well as to the government itself. I need not remind you that the federal government is the largest building owner in this nation and as such, has a direct and fiscal interest in advancing construction technology and improving construction performance.

Yours very truly,

FRED GOOD, *Executive Vice President.*

JOINT COMMITTEE ON PRINTING,
Washington, DC, March 22, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Senate Committee on Commerce, Science and Transportation, Washington, DC

DEAR MR. CHAIRMAN: It has been brought to my attention that the National Technical Information Service (NTIS) has requested changes in its enabling legislation that would permit NTIS to obtain printing services without regard to the Government Printing Office (GPO). I strongly oppose any such change.

The reasons propounded by NTIS to support the request are simply without substance. Those reasons, as offered in Congressional testimony, include "improved control . . . over scheduling of production, better quality control, and lower costs." Please allow me to address each point in turn.

The criticism of the printer for scheduling difficulties and failure to meet delivery dates is prevalent throughout all of publishing. While the printer is occasionally at fault, far more frequently the printer is simply the scapegoat for bad planning, preparation and scheduling. In those rare circumstances where exigencies demand a quick response to a printing requirement, the Government Printing Office is well-equipped, through a variety of mechanisms, to produce or procure whatever is required.

Likewise, since NTIS and GPO each would have to rely upon a commercial contractor, it is difficult to imagine a reason why an NTIS contractor would produce greater quality than a GPO contractor. GPO can procure any level of quality that is desired.

Finally, it is equally hard to imagine how NTIS could acquire their products at lower prices than are available through GPO. The GPO has a list of potential contractors that exceeds 8,000 names. Competition for work is extremely strong. NTIS procurements are not likely to be exposed to such competition.

In addition, NTIS procurements would require the dedication of appropriate NTIS staff time to contract writing, contract administration and contract dispute resolutions. These things are all available through GPO for a minimal administrative charge. For NTIS to duplicate these functions would be patently wasteful. To illustrate this point, in 1984 NTIS was billed 768 times by GPO for separate printing orders that in total cost slightly less than $1.2 million. To process and administer that number of orders, GPO charged NTIS approximately $59,000, or about 5 percent of the total billing. It is highly unlikely that NTIS could have performed all of the contracting functions themselves for $59,000. Therefore, allowing NTIS to obtain printing on its own will likely result in higher costs overall.

The Federal printing program, with GPO at its center, was established to take advantage of principles of centralization and economies of scale. GPO personnel are trained specialists at the function they perform. They administer a highly competitive system in which the overwhelming majority of competitors are small businesses. To begin fragmentation of such a proven system simply to accommodate an agency's ill-founded assertions or suppositions would be detrimental to efficient government administration.

I strongly urge you and the other Members of your committee to reject the change requested by NTIS.

With every best wish, I am

Sincerely,

FRANK ANNUNZIO, *Chairman.*

U.S. SENATE,
COMMITTEE ON RULES AND ADMINISTRATION,
Washington, DC., March 22, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, U.S. Senate, Washington, DC.

DEAR SLADE: I would like to call your attention to the assistance recently rendered to the Senate by the Institute for Computer Sciences and Technology (ICST) in the National Bureau of Standards.

As you may be aware, a fire was discovered in a Prime Computer, Inc. disc drive cabinet in Senator Heinz's office late in the evening of February 28, 1985. The following morning we called on the ICST for assistance. Before noon of that day experts from the Institute and the Center for Fire Research were on hand advising us on the recovery of vital files and the investigation of cause. Other persons on its staff were prepared to come here but were not needed when it was determined that damage was confined to the computer equipment and carpeting. The ICST and the Center for Fire Research then arranged for the Underwriters Laboratory to conduct an independent analysis of the damaged equipment. Representatives of both the ICST and the Architect of the Capitol's office were in attendance as the equipment was disassembled in the UL facility.

My primary concern is, of course, the safety of Senate employees. I want to be assured that the equipment we authorize for the Senate is safe as well as functional. I know of no source other than the Institute for Computer Sciences and Technology—in government or elsewhere—where I can be assured of impartial and expert advice in matters of this sort.

I am concerned that there is consideration for sharply reducing, or entirely eliminating, ICST capability. I find that contrary to our interests and I strongly urge that their capability be maintained at, or near, present levels.

Sincerely,

CHARLES MCC. MATHIAS, Jr., *Chairman.*

GLENN ASSOCIATES, INC.,
Arlington, VA, March 22, 1985.

Hon. SLADE GORTON,
U.S. Senate, Subcommittee on Science, Technology and Space, Hart Senate Office Building, Washington, DC.

DEAR SIR: Speech technology is rapidly becoming an important component in computer science and technology. Within the past several years many commercial products have become available to augment the man-machine interface using speech. The expected growth of this technology will significantly impact the nature of our use of computer technology.

As a professional with many years of experience in the development and application of speech products, and as Editor-in-Chief of Speech Technology magazine, I recognize the value of the program in speech I/O technology at the National Bureau of Standards' Institute for Computer Science and Technology. This program serves an important role in meeting needs for testing procedures, and research and development of standards in cooperation with industry.

I understand with regret that proposed budget cuts for fiscal year 1986 may threaten the ability of NBS to continue to provide leadership in standards development for computer science and technology. To my way of thinking, continued support of standards development is extremely important, and this represents an inappropriate reduction in federal support for science and technology.

Please take the necessary steps to see that these programs are maintained at at least the current levels of funding. Thank you for your attention to this issue.

Sincerely,

JAMES W. GLENN, Jr., *President.*

COMPUTER SECURITY ANALYSTS,
Alexandria, VA, March 25, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, U.S. Senate, Hart Senate Office Building, Washington, DC.

DEAR SENATOR GORTON: The news media over the past few months has reported that the Administration's FY 1986 budget proposal would cut $5 million dollars from the authorization of the National Bureau of Standards' Institute for Computer Science and Technology and that such a reduction would eliminate their on-going computer security program. It is rather ironical, that at the very time when computer crime is on the increase and the need to protect informational resources is at last being understood, the Government would consider the elimination of the only national program addressing these issues for both the public and private sectors.

TRW Systems, Inc., in a study on computer systems security conducted over ten years ago for IBM, pointed out the following:

"* * * providing only physical security is no longer valid for information protection.* * * With concurrent sharing of a computer system, the opportunity is present for inadvertent, accidental, or malicious acquisition of information by a user who has no right of access."

The "Hackers" of today have validated this statement many times over. As a computer security consulting firm, it is our opinion that a strong research and development program is essential if adequate protection of informational resources is to be obtained.

I do not intend to imply that there has been no effort in this direction outside of the Institute for Computer Science and Technology. The Federal Automatic Data Processing Users Group, the Interagency Audit Council, and the President's Council on Integrity and Efficiency all have special interest groups or committees addressing portions of the problem. The same has been true in the private sector where professional societies, user groups, trade associations, and others have established groups to study the issues involved in protecting information resources.

Such efforts have made their contributions; however, "special interest groups" and committees have inherent disadvantages:

Members often participate on a part time basis and are seldom given the time and resources to fully address the issues involved;

Issues are usually examined on an ad hoc basis and from the single perspective of the group involved;

Often there is little interaction between such groups; and

Information developed is not normally disseminated outside of the group's membership.

In my judgement, it is important that the Federal government continue their leadership role in this complex field and serve as a focal point to promote security awareness, foster advanced research, and disseminate information on ways and means of protecting information resources. It would seem logical and most cost effective for the Institute for Computer Science and Technology to continue to exercise this responsibility.

Five million dollars is a small price to pay when you consider the ICST's computer security programs are directed toward the protection of billions. I strongly suggest that you consider supporting the restoration of the proposed budget cut for the Institute.

Sincerely,

ROBERT G. MCKENZIE, *Partner.*

U.S. POSTAL SERVICE,
SPECIAL INVESTIGATIONS DIVISION,
Washington, DC, April 2, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Space, and Technology, Committee on Commerce, Science, and Transportation, U.S. Senate, Washington, DC.

DEAR SENATOR GROTON: This letter will reference a conversation with Ms. Woods concerning the National Bureau of Standards (NBS), Center for Fire Research. As you are probably aware, in October 1984 our Headquarters building at L'Enfant Plaza received substantial fire and water damage. The initial investigation by the D.C. Fire Marshals and the Bureau of Alcohol, Tobacco, and Firearms (BATF) National Response Team resulted in an inconclusive determination as to the cause of the fire. The Bureau listed the fire as "undetermined origin" and the City listed it

as "undetermined" and "suspicious." The investigation conducted by the Inspection Service was initiated after the City and BATF terminated the investigation. In the area identified by BATF as the fire origin, we located an appliance that was considered suspect.

The appliance, identified as a Wang computer power source, was sent to the National Bureau of Standards, Center for Fire Research, for analysis to determine if the unit had failed and caused the fire. NBS was very responsive in providing us with experts from the Center for Fire Research who examined the applicance at their laboratory in Maryland. Additionally, with NBA's help, we reconstructed the office configurations in the area where the appliance was located and which was identified by BATF as the lowest point of burn or the fire origin. NBS conducted burn tests on the office furniture to determine the rate of burn of the combustibles.

We consider their assistance to be most valuable in providing us with possible answers as the how the fire started. NBS was very responsive to our needs and professional in their approach. We did not make a determination as to whether or not this type of assistance was available in the private sector. We felt more comfortable dealing through another government agency in recognition of their independence from business motives. I hope this letter will assist you in making your determination relative to the Center for Fire Research.

Sincerely,

J.H. HANNEY, *Inspector in Charge.*

U.S. CONSUMER PRODUCT SAFETY COMMISSION,
Washington, DC, April 3, 1985.

Hon. SLADE GORTON,
Chairman, Subcommittee on Science, Technology and Space, Committee on Commerce, Science and Transportation, U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: In response to your inquiry, regarding the Consumer Product Safety Commission's reliance on the Center for Fire Research at the National Bureau of Standards (NBS), I am pleased to provide the following information.

Section 29(d) of the Consumer Product Safety Act states: "The Commission shall, to the maximum extent practicable, utilize the resources and facilities of the National Bureau of Standards, on a reimbursable basis, to perform research and analyses related to risks of injury associated with consumer products (including fire and risks from flammable fabrics), to develop test methods, to conduct studies and investigations, and to provide technical advice and assistance in connection with functions of the Commission."

The Commission has worked productively with the Center for Fire Research since CPSC was activated in 1973. The areas of cooperation over the years are: Toxicity of Combustion Products, Upholstered Furniture Flammability, Fire Growth Research, Heating Equipment and the Cigarette Safety Act of 1984. The CFR has also advised the Commission on smoke detectors, smoke masks, mattress and apparel flammability, and fire data analyses. This relationship has been both productive and beneficial.

I hope this information is helpful. Please let me know if you have any further questions.

Sincerely,

TERRENCE SCANLON, *Chairman.*

DATRON INSTRUMENTS, INC.,
Stuart, FL, April 8, 1985.

Hon. SLADE GORTON,
U.S. Senate, Committee on Commerce, Science and Transportation, Hart Senate Office Building, Washington, DC.

DEAR SENATOR GORTON: This letter is being offered as written testimony on behalf of the U.S. National Bureau of Standards.

I would like to bring to the attention of your Committee my feelings concerning the position of the United States National Bureau of Standards as compared to other National Standardizing Laboratories throughout the world in the area of research and development, specifically concerning advancement of the "State of the Art", the highest level of technology in the world.

At the current time, I am the President of Datron Instruments, Inc., a manufacturer of test and measurement equipment including electronic calibration standards. I have personally been in this industry since 1960 and have been involved with

NBS and most of the major National Laboratories throughout the world. I have had the opportunity to see how other countries function in the area of National Standards and their relationship with their nation's industries. I would like to point out that over the past 25 years, the United States has made very few contributions to the International Metrology community. At the present time, the United States National Bureau of Standards is maintaining many of our nation's electrical standards with instrumentation utilizing "State of the Art" technology which has been developed by National Laboratories of foreign countries. I would like to highlight some of the more important developments in electrical measurement techniques that have occurred over the past number of years. Most of the advances in the "State of the Art" come from the work of experimenters in establishing and maintaining the units in the National Laboratories. It appears that NBS has picked up on the ideas and developments of other laboratories and further enhanced their use, but in the true sense of research and development, NBS appears to trail behind other National Laboratories and come up with new ideas.

Examples of these follow:

The International Unit of Resistance and capacitance including parameters which are maintained at the National Bureau of Standards are based upon the computable capacitor. This theory and original work was discovered by Thompson and Lamphart of the Australian National Laboratory.

The Current Comparative principle which is now used at the National Bureau of Standards to maintain the National Unit of Resistance was developed by Kusters and Moore of the Canadian National Research Council. Current comparator instrumentation was the basis for maintaining AC Standards of Ratio, DC Standards of Voltage and Resistance. NBS felt that this development was significant that it set up a separate group within the Bureau to study and further develop the current comparator principle.

In the field of AC Inductive Dividers, J.J. Hill of the British National Laboratory pointed the way to do AC Resistance Thermometry employing these dividers. Here too, the Bureau has picked up on this idea and further enhanced it.

In the field of Resistance Standards the device commonly known today as the Hammon Transfer Standard was developed by the Australian National Laboratory. Here again, NBS picked up on this idea.

In the area of AC/DC Transfer Measurements, the United States led the way for many decades, but, about twenty years ago, the concept of the multijunction thermal converter was produced by work originally carried out in the National Laboratories of the USSR and Great Britain. These devices which were manufactured in Canada are presently being used by NBS as our nation's standards.

More recently, in the area of the absolute determination of the Ohm, it appears work being done by the German National Laboratory will be the new International Determination of the Ohm.

In the area of energy measurements which is of great concern to most of the world and work being done in Japan and in Canada seems to be the best being accomplished today.

As far as R&D here in the United States, in the area of electrical units and National Standards, one of the contributions made by U.S. industry and here again, picked up by NBS was the work done on the DC Josephson's Junction which involves the unit of voltage; this work was carried out at the University of Pennsylvania and now is being used as the U.S Legal Volt and also throughout most of the International Metrology community.

In addition to not being at the forefront of technology in this area, NBS fees for calibration service are the highest in the world and in many cases the charges are disproportionate to the original cost of the product being calibrated, i.e., a standard resistor can be purchased for $510.00 from the manufacturer and which includes a calibration. If this same resistor is simply recalibrated by NBS the cost is $374.00. The cost is 73% of the original purchase price.

In summarizing the above, it is evident to someone who has been in this industry for almost two and a half decades that the United States seems to lack initiative and the funds to develop new standards.

It is imperative that NBS be given funds to enable the United States to become a dominant factor in the field of International Metrology.

Very truly yours,

EDWARD NEMEROFF, *President.*

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